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THE USE OF ORGANIZERS, OBJECTIVES AND QUESTIONS
IN THE PREPARATION OF PROSE INSTRUCTIONAL MATERIALS

BY



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A THESIS

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ABSTRACT

The purpose of this investigation was to assess the instructional value of advance organizers, instructional objectives and adjunct questions in preparing instructional prose. Previous research relating to each of these manipulations led to some questions both about their forms and the methodologies most commonly used. Alternative forms of organizers, objectives and questions were derived from analysis of their hypothesized functions and their current use in applied instruction. The two forms of each manipulation, one drawn from current use in the literature and one devised in the light of instructional practices, were investigated within a factorial research design.

Data analyses indicated that the prose organizer performed significantly better than the graphic-word organizer. This unexpected effect was accounted for in terms of students' possible preferences for and abilities with verbal rather than visual information sources. Failure to obtain differences between either form of objectives and questions was attributed to their lack of use by the students. This lack of use was thought to result from relatively low motivational states inherent in the research context.

Differences obtained between scores of students given instructional manipulations and those given text only were discussed as supporting the contention that equal available time does not lead to equal performance. However, low magnitude of scores within treatment groups and low magnitude of differences in treatment effects suggest that further research demonstrating stronger facilitation effects are necessary before

firm conclusions, relative to the value of inserting organizers, objectives and questions in text, can be made.

Differences between prose and graphic-word organizers and changes in research strategies were discussed as areas which should receive further research attention. It was concluded that students' motivation levels may be a more critical issue in relation to "instructional" research in which an attempt is being made to promote learning phenomena than is the case in "learning" research where an attempt is made to study and draw inferences about the learning process.

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CHAPTER I

The purpose of this investigation was to assess the instructional utility of advance organizers, instructional objectives and adjunct questions as manipulations which promote learning from prose materials. Each of the manipulations was examined in two forms, a form which is commonly used in the published literature and a new form derived from instructional practice. The relative utility of both forms of the three manipulations in improving learning from prose was assessed by means of a research design in which one or the other form of all three manipulations was presented within prose materials.

In Chapter I, the research rationale and literature reviews relating to organizers, objectives and questions are presented. Problems identified by the literature reviews are discussed in terms of some current instructional positions and procedures. New forms of organizers, objectives and questions are derived from these discussions.

In Chapter II, the production of materials, the research design and the methodology is described. The data and results are presented and discussed in Chapter III and Chapter IV presents some conclusions, implications and suggestions for further research.

The basic orientation of this research is instructional which, according to Gagné (1974), means that attention is directed towards:

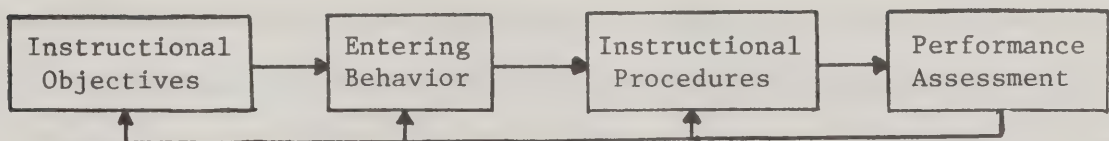
... the set of planned external events which influence the process of learning and thus promote learning. ... The external events do not produce the learning -- instead they potentially support processes which are occurring within the learner. (p.5)

While instruction is not media specific, consideration of instructional issues must be made manageable by constraining or limiting

the domain of interest. In this investigation, prose or text materials will be the particular medium of interest. This selection is based in part upon Gagné's statement that: "The kind of learning the reading of books accomplishes most is the learning of information (1974, p.6)" and in part, upon the recognition that prose materials remain one of the most readily available sources of information.

While prose materials are used extensively in many learning contexts, relatively little attention has been directed towards determining what 'planned external events' are necessary to convert ordinary text from which students might learn into instructional prose which will support the students' learning processes. No systematic body of research or theory exists from which prescriptions for the production of prose instruction may be derived. There are, however, a number of sources of information which can contribute to this process.

Glaser's basic teaching model, for example, (in DeCecco & Crawford, 1974) provides a graphic display which can be used to organize the variables which will be under consideration.



The four blocks represent four major components of the instructional sequence and are equally applicable to classroom or prose instruction. According to this model, effective instruction must provide for the requirements of each of these interrelated components, the instructional objectives specifying the information or skill to be acquired, the entry behaviors relating to the students' existing information, skill, ability and motivation, the instructional procedures which will draw the

students from their initial information or skill position to the one specified by the objectives, and performance assessment which will ascertain whether or not the desired change in behavior has occurred.

In order to use prose materials as essentially autonomous instruction which is intended to promote learning without the assistance of a teacher, it seems important to examine some of the ways in which prose might be modified to provide support for students learning processes.

Three manipulations have been selected for use in this investigation for several reasons. First, while all three manipulations arise from or are associated with somewhat different areas of research and theory, organizers from Ausubel's (1963) theory of meaningful verbal learning, objectives from military and industrial contexts via Mager (1962), and adjunct questions associated with Rothkopf (e.g. 1970), Frase (e.g. 1970) and Anderson (e.g. 1970), each of these manipulations is viewed by their proponents and have received some empirical support, as "planned external events" which can support the students learning process.

The second reason for the selection of advance organizers, instructional objectives and adjunct questions is their particular appropriateness for use with prose since they are themselves most frequently used in printed form. A third reason for the selection of these manipulations is their discreteness from the prose material itself. This discreteness means that the manipulations can be changed without directly changing the prose. Thus, the author of the organizers, objectives and questions need not necessarily be the author of the prose. This is a particular advantage when it is remembered that the individual preparing instructional prose may not be an expert in the subject matter of the prose.

A fourth, and final reason for the selection of organizers,

objectives and questions in this investigation is the fact that these manipulations are used in applied instructional contexts (e.g. Courseware, Inc., 1974) and the view expressed by one of these practitioners (Merrill, 1976 personal communication) that if it is not possible to do anything else, the provision of organizers, objectives and questions may be a sufficient condition for promoting learning from prose.

While the rationale underlying the use of organizers, objectives and questions is relatively strong and cogent, it is also true that each of these variables is associated with some problems of a theoretical or applied nature. The literature reviews which follow describe the problems associated with each of the manipulations. Guidance is then drawn from current instructional practices to produce revisions to the manipulations which may improve them for use as "planned external events" which will support students' learning processes.

A Selected Review of the Literature

All three of the manipulations to be considered have received substantial attention in the published literature for at least 10 years. The result has been a very large collection of reports and position papers. In addition, the literature relating to all three manipulations has been reviewed within the past few years and these reviews are available in published form. This review will therefore refer directly to the published reviews and discuss in detail only those papers which have some particular relevance to this research.

Advance Organizers

According to Ausubel (1968) the single most important prerequisite for meaningful verbal learning is the existence, within the learner's cognitive structure, of suitable "anchoring ideas" for the new learning.

He views the process of learning as the organization of new material in a hierarchical manner within the learner's cognitive structure. Thus, to Ausubel, support of the learner's processing requires provision of appropriate anchoring ideas which can be made available by means of "advance organizers".

Advance organizers are materials prepared at a "higher order of generality and inclusiveness" than the new learning materials and their relevance to the new learning materials is made explicit.

In a recent review by Barnes and Clawson (1975) 32 studies are described. Of the studies presented only 12 (approximately 38%) showed significant facilitative effects for the use of advance organizers in learning from prose. In addition, Barnes and Clawson (1975) analysed the studies in terms of length of study, ability level of students, type of organizer, and cognitive level of the learning task and failed to find clear patterns emerging.

It is interesting to note that a number of other researchers, (Dooling & Lachman, 1971; Bransford & Johnson, 1972; Dooling & Mullet, 1973) whose papers were not included in the 1975 review, have suggested that advance organizers may have a facilitative effect on performance scores but only when the new learning material itself is not conducive to the learner's production of his own organizer. For example, Dooling and Mullet (1973) presented vague metaphorical stories with or without an organizing title. They found, with material from which a student was unlikely to draw his own organizing title, the presence of a title improved performance. It is important also to note that these authors, while referring to their manipulations as advance organizers, actually employed "organizing titles" and "single word themes". These uses of

"advance organizers" seem to differ in terms of their length and complexity from the advance organizers used by Ausubel.

Another type of organizer found in the literature may have instructional potential. Barron and Stone (1974), for example, presented learners with a "graphic-word" organizer. This organizer appears to be essentially a flow-chart of the main concepts in the learning materials and of the relationships among concepts. In their research, one group received the experimenter-produced organizer prior to the new learning material and was encouraged to discuss and elaborate the organizer with the experimenter. A second group received the learning passage first and was then encouraged to generate their own organizer in small groups. A third group was simply asked to read the material. In terms of performance scores, the post-organizer group exceeded the pre-organizer group which exceed the control group. Barron and Stone (1974) argued from these results that organizers may have their influence on students' "reading/learning process rather than ... on cognitive structure." They do not, however, offer much explanation for the superior performance of the post- compared to the pre-organizer group, nor do they discuss the issue of interaction with experimenters in the production of pre-organizers or interaction in small groups in the production of post-organizers. The issue of the relative efficacy of graphic-word organizers in comparison to prose organizers, therefore, seems to have arisen but in this research, has been confounded with interaction between student and experimenter production.

What an organizer is and how it works, if indeed it does work at all, are issues towards which some comment has been addressed. Barnes and Clawson (1975), for example, conclude that research using advance

organizers has suffered from the absence of an operational definition of the term. This concern has also been reflected by Blanton (1971), Barron and Cooper (1972), and Hartley and Davies (1976) all of whom criticize the lack of operationalization of advance organizers.

Summary and Critique

In reviewing organizers, Barnes and Clawson (1975) conclude that there is no substantial evidence supporting advance organizers as facilitators in learning from prose. There seems, however, to be some indication in the research cited by these reviewers that the distinction made by Ausubel (1968) between derivative and correlative subsumption may have been ignored. According to Ausubel (1968) derivative subsumption occurs when the learning material is a specific example of a concept already existing in cognitive structure. Correlative subsumption occurs when the learning material is an extension or elaboration of previously learned propositions (Ausubel, 1968, p. 100). Because he views the consequences of obliterative subsumption to be more severe in the case where correlative subsumption is the desired process it seems that this is also the situation in which advance organizers are most important and effective. With relatively little detailed information available from which to establish whether derivative or correlative subsumption was the process being promoted it is not really possible to comment further. However, it is possible that research in which the learning material was a specific example of a concept already existing in cognitive structure was among those which failed to demonstrate the usefulness of advance organizers.

Barnes and Clawson (1975) make a number of suggestions for additional research using advance organizers. Specifically they suggest:

Studies using a wide variety of nonwritten advance organizers

that are operationally defined and constructed according to the general criteria espoused by Ausubel should be conducted. (p. 656)

It is this particular suggestion which will be considered in terms of some current instructional practices.

An Instructional View of Advance Organizers

In the literature reviews cited, the only consensus seems to be an awareness that while organizers sometimes appear to facilitate learning from prose, their use is associated with methodological difficulties particularly in terms of an operational definition.

There are two characteristics of Ausubel's (1962) version of the organizer which are not made explicit from the definition. First, it is 450 words long; second, the organizer uses a number of relatively sophisticated technical terms. These characteristics of length and language seem to be potential problems when an organizer is intended for a student's use. This may account for the comment from Barron and Cooper's (1972) students that they viewed the organizer as "additional learning materials." It may also be the reason why Ausubel's use of organizers has been most successful when the organizer is presented on several occasions prior to the new learning materials.

However, instructional psychologists, for example, Merrill (personal communication, 1976) also advocate the use of some type of "organizer" or introductory material which is similar to Ausubel's advance organizer, in intent if not form. In a list of Basic Requirements (Courseware, Inc., 1974) a description of "instructional sequence relationships" is advocated. In essence, this description is usually a relatively short, often schematic, flow chart of the major concepts of an instructional sequence showing how each concept is related to other concepts. The

intent of this "display" seems basically to show the student where he has been, where he is and where he is going with respect to the learning material. Merrill (personal communication, 1976) considers this "sequence relationships display" to be comparable to Ausubel's advance organizer since its intent is to provide the student with a context in which he might relate the new learning to what he already knows. It is not clear whether this "display" is intended to be a superordinate organizer or an overview.

There are two characteristics which make this instructional organizer different from Ausubel's organizer. First, it is relatively short in length, often a few sentences or a simple flow chart arrangement of words (similar to the "graphic-word display" used by Barron and Stone, 1974). And second, it is usually presented in language with which the student is familiar.

An organizer, derived from an instructional context, therefore, is similar in intent to Ausubel's advance organizer but differs in two specific ways. Descriptively, an "instructional organizer" seems to be:

Introductory material presented at the beginning of an instructional segment making explicit, often in diagramatic form, the relationships among concepts in the learning materials. It is intended for the student's use throughout the instructional sequence and must therefore be relatively short and use language which exists in the student's repertoire.

It is argued, in this paper, that these two characteristics of length and language may be critical in determining the utility of organizers in prose material. Therefore, it is proposed in this study, to produce an "instructional organizer" as described and to compare its utility to the original (1962) organizer which Ausubel and his colleagues produced for use with the same text materials. The "operational rule" used in the

production of the graphic-word organizer is discussed in the materials production section on p. 31. The intent here, is not to determine whether organizers "provide subsumers in cognitive structure" or "tell the student where he is, where he's been and where he's going." Rather, an attempt will be made to determine whether the instructionally described organizer specifying a shorter and simpler language form will lead to improved performance scores in comparison with performance scores produced using the original organizer.

In summary, since one of the problems associated with the use of advance organizers seems to have been the lack of operationalization, a typical advance organizer (Ausubel & Fitzgerald, 1962) will be compared with an alternate organizer which has been described and derived from an instructional perspective.

Instructional Objectives

Instructional objectives are variously described by their proponents but whether referred to as instructional objectives, behavioral objectives, or performance objectives they usually have some characteristics in common. That is, objectives are generally statements about the learning task outcome, couched in terms which make apparent to the students what it is they will be expected to do. The most prevalent definitions (e.g., Popham & Baker, 1970) of objectives usually include reference to the performance expected, the conditions under which the performance will take place and the criterion for success (e.g., 100% or 80% correct).

Instructional objectives have received a great deal of attention over the past 10 years. In 1971, the Canadian Teachers' Federation produced a comprehensive bibliography of over 350 books, papers and

articles (cited in Geis, 1972). Additional reviews have been published by Ammons (1969), Geis (1972), Deuchastel and Merrill (1973) and Lawson (1974). In 1969, Ammons concluded that:

... First, the terms themselves have no universally accepted definition so discourse about objectives occurs on several levels of generality. Second, a statement of objectives or a recommended methodology for determining objectives is almost always couched in value terms, which renders empirical research in the classical sense difficult. Third, the question of what objectives ought to be sought has a history which dates from at least Plato. Fourth, pronouncements about objectives are more or less explicitly analyzed and justified opinions. Fifth, studies of a largely empirical nature in relation to objectives are few compared to the number of statements based upon individual or group opinion. (p. 908)

Geis (1972) generally concurs with Ammon's (1969) conclusions but suggests that:

... it would be a shame if the momentum and forward thrust started by Mager's little book (if the anxiety which may be the motive force of the movement toward more explicit description of education goals) were blunted or dissipated by total uncertainty. (p. 16)

and further recommends that:

... much more research is called for to support and shape practices. Behavioral objectives allow research to occur; they provide unambiguous material for study. This is a benefit in itself. (p. 17)

Deuchastel and Merrill (1973) consider objectives as having three main functions in terms of:

- a) direction for teaching and curriculum development.
- b) guidance in evaluation.
- c) facilitation of learning.

It is the third function, the facilitation of learning towards which their review and the goals of this research are directed. After reviewing 27 studies Deuchastel and Merrill conclude that results from studies comparing groups with and without objectives were at best

inconsistent with equal numbers obtaining and not obtaining differences between experimental and control groups. They considered the studies in terms of topic or subject matter, level of schooling, and time or duration of instruction. None of these factors produced any more consistency or clarity since successes and failures occurred with each of them.

Deuchastel and Merrill (1973) express concern that the results of their review may be overgeneralized to affect the use of objectives in curriculum planning and evaluation when their review directly addressed the issue of objectives in the facilitation of learning. In reference to facilitation of learning, Deuchastel and Merrill (1973) recommend that even with the inconsistency obtained, the use of objectives apparently is non-damaging and should therefore continue.

Lawson (1974) reviewed instructional objectives in terms of their role in promoting attending behavior, the degree of specificity of objectives and the effects of their location or placement. As in the other reviews cited he found the results equivocal. In reference to the promoting of attending behaviors, Lawson (1974) concluded that objectives are helpful in promoting attending behaviors, and in situations where the objectives are salient to the learning task, do promote learning. He found the research relating to specific and general objectives so variable in details that neither comparisons nor conclusions could be made. In addition, he suggested the issues of timing and placement may account for differences obtained when using specific and general instructions. With reference to timing and placement, Lawson (1974) suggested that presentation of lists of objectives before relevant instruction may consist of an interpolated learning task thus inhibiting performance. Further, he suggested that interspersed objectives may provide "cue-

producing stimuli for elicitation or shaping of efficient attending behavior which, in turn, enhance comprehension and retention." (p. 13)

Summary and Critique

There are a number of enduring problems associated with the use of instructional objectives to facilitate learning. As noted in each of the reviews discussed, the conclusions from research evidence must remain equivocal. The current status of research with instructional objectives provides little substantive support for the use of objectives in learning from prose instructional materials. In particular, few specific generalizations appear plausible in relation to the critical operational characteristics of objectives.

There are several problems in evaluating research papers in the use of objectives to facilitate learning. First, there is the issue of definition. Objectives used in the papers reviewed by the authors previously cited vary from the well-operationalized statements which include behavioral indicators, specification of conditions, and specification of criteria through rule-like statements, vague general statements and specific reference to one text sentence.

A second methodological problem in this literature is the manner of presentation. It is not always possible to determine whether the objectives were presented prior to instruction in list form, verbally or on paper, interspersed throughout instruction in a pre- or post-location in reference to the relevant instructional segment, or in a massed post-location. Any one of these variations and many other means of presentation have occurred in the research described by the reviews. Very few authors appear to consider presentation mode an important issue. Only one (Papay, 1971) explicitly considered the massed/distribution issue.

A third, related issue was addressed by Kaplan and Rothkopf (1974) and Rothkopf and Billington (1975) who demonstrated the density (number of relevant text sentences in relation to number of objectives) is a factor which influences whether objectives may be achieved. Other than those cited papers, many authors don't discuss the relationships between presentation manner, massing or distributing, oral or written, pre- or post-presentation, or amount of text relevant to objectives. Whether all of these factors may have substantial influence of the relative efficacy of objectives for learning remains an empirical question.

A fourth issue, which has received little attention is that of the structuring of the learning materials themselves. In many cases no examples or descriptions of the organization of the materials have been provided. However, in research where the instructional materials were explicitly organized and highly structured no support has been obtained for the use of objectives. (e.g., Etter, 1969; Merrill, 1970; Smith, 1970; Merrill & Towle, 1971) This lack of effectiveness with highly structured materials may be the evidence that structural features of materials are important factors in the use of objectives. For example, it may be that when the materials themselves have been organized on the basis of objectives, then nothing further is gained by explicitly providing objectives.

These four issues, operational definition, presentation type, density and structure of materials seem important considerations which if not directly investigated should at least be made explicit and controlled. Only the issue of operational definition, in terms of intended function will be directly addressed in this study. The other factors

will be described and controlled.

An Instructional View of Objectives

The use of instructional objectives arises from an instructional context and is based essentially on an attempt to have teachers and other professionals make explicit behavioral statements which they will accept as evidence of a student's mastery of an objective. Great effort is made by proponents of objectives (e.g. Popham & Baker, 1970) to help the professional to produce and use non-trivial objectives. Their relative success in this respect has been demonstrated by the extensive support for and use of objectives throughout many educational texts. This concern with non-trivial objectives and with making explicit the behavioral aspect of a student's response is not the characteristic of current research in the use of instructional objectives. Indeed, some research (e.g., Rothkopf & Kaplan, 1972) which carefully defines a "specific objective" as one which can be answered by one text sentence seems to be directed towards evaluating "trivial" objectives. At the same time, it essentially ignores the concerns with the student's response and the conditions under which it will be made which are the critical concerns for the production of objectives in the first place.

The argument to be presented here is not basically directed to the practical use of objectives in instruction but specifically to obtaining empirical evidence about their usefulness. It seems necessary to determine at the outset, what we intend objectives to do. If, for example, objectives are "orienting stimuli" as Rothkopf and Kaplan (1972) seems to believe, perhaps the most effective strategy would be to simply number sentences then say, "Look at sentence 10."

The original point of the objectives movement, however, seems to have

been to draw attention away from exclusive centering on content issues to considerations of "what should the student do." The main claim for the utility of objectives presented to the student has been that they tell the student what he will be expected to do after the instruction. It seems useful, therefore, to consider objectives in terms of this critical feature and to determine whether it might be the only necessary feature of objectives which are to be presented to students in order to improve performance. There is some evidence (e.g., Carey & Lockhart, 1973) that students who are told they will receive a recall test, perform differently from students who are told they will receive a recognition test. Perhaps the prior information about what kind of test they will get is a critical component for objectives.

A second related characteristic seems to be the information level of the test. For example, it may be useful if the student knows that he will be tested on single details (verbatim) or on several related details (paraphrase).

In the research literature, there are a number of explanations to account for the lack of success in using objectives. One common explanation is that "the students didn't know how to use them." Several researchers (Kurtz, 1972; Morse & Tillman, 1972) have attempted to teach students how to use objectives, but with no improvement in performance. It seems plausible to hypothesize that even when an objective is "well written" it may not be useful to the student simply because it is presented before the student knows anything about the content, consequently the student cannot make use of content references. If, however, a student is told that his objective is to answer a multiple-choice or a short-answer question which deals with specific details or with

relationships among concepts, this may be useful information to him even without his knowing the content in advance. It is proposed in this study to produce objectives which are entirely "content-free" and to compare their effectiveness with the effectiveness of traditional objectives which, while having a "task" or behavioral reference may have this reference obscured in a content statement with which the student is unfamiliar.

The intent is not to comprehensively evaluate the hypothesized functions of objectives. It is recognized that they may have many functions beyond the "task cue" function discussed here. However, it seems useful to attempt to isolate a critical component and to assess its usefulness in relation to the traditional approach which has not, at this point, received a great deal of empirical support.

In summary, the plan in this study is to prepare two types of objectives: First, objectives which have explicit content references (content-referenced); Second, objectives which specify the type of response (open-ended or multiple-choice) and the kind of information (verbatim or paraphrase). The latter are referred to as "content-free" objectives.

Adjunct Questions

The use of questions as aids to learning is not new and the research related to the use of inserted questions or test-like events is currently associated with Rothkopf and Frase who have published numerous papers in the area. Rothkopf (1970), for example, describes his interest in adjunct questions as a means of influencing "mathamagenic" behavior. Mathamagenic behavior is a term coined by Rothkopf to describe any activity, such as answering questions, which a learner engages in and which promotes or "gives rise to learning." According to Rothkopf (1970) these activities

consist of orientation, object acquisition and translation and processing. It is this latter, translation and processing function which is the primary role of inserted questions according to Rothkopf (1970). Rothkopf views adjunct questions as a means by which the experimenter can influence this translation and processing behavior thereby ensuring the student converts "nominal" into "effective stimuli." This position is consistent with Craik and Lockhart's (1972) "Levels of Processing" hypothesis which also postulates the importance of the qualitative interaction of student and materials. Both these positions are consistent with the instructional interest in a mechanism or strategy which will support the students' learning processes.

There are two basic claims made for the facilitation of learning by inserted question. First is the claim of "direct effects", that is, the effects of inserting a question within the text on performance on the same question in subsequent testing. This is usually referred to as a repeated or relevant test item. The second is the claim of "indirect effects", that is, the effects of inserting one question in the text on the performance on a different question on subsequent testing. The latter type of test item is usually referred to as a novel or irrelevant test question.

The claims for direct and indirect effects of questions in learning from prose are closely associated with the issue of location or placement of questions in text. The most common arrangement for questions has been a pre- or post-location, that is, either preceding or following the text material.

The issue of direct, indirect and location effects have been rather extensively considered in the research literature. Anderson and Biddle

(1975) after a thorough review of current research, conclude that there is substantial evidence for the direct effects of both pre- and post-questions. They also found evidence for smaller but consistent indirect effects of post-questions. They point out that generally, direct effects are four times greater than indirect effects.

Both of these conclusions should, however, be considered in the light of other authors who were not represented in Anderson and Biddle's (1975) review. Specifically, Ladas (1973) criticizes the evidence presented to support the claim of indirect effects of questions on two grounds. First, he criticizes Rothkopf (1966) and Rothkopf and Bibicos (1967) on the grounds that they employed a posteriori multiple t-test. Second, Ladas (1973) points out two other papers (Frase, 1967; 1968) failed to include control groups. Subsequent data presented by Hiller (1974), Swenson and Kulhavy (1974) and Wilson, Koran and Koran (1974) also represent failure to support the indirect effect of questions on the learning of unquestioned material.

Arguments against the claim for the direct effects of questions are somewhat less empirically based but nevertheless compelling. Carver (1972) addressed the problem of lack of control of time as a relevant variable. He pointed out that on the whole, questioned groups took more time than non-questioned groups. He argues that Rothkopf's data does not contribute to the important issue of learning "efficiency" which relates to whether, if time was constant, the performance of the questioned group would still exceed the performance of the unquestioned group. Other researchers, for example, Peeck (1970), Morasky and Willcox (1970) and Corrozi (1971) found that when time with materials is controlled or equated performance differences between questioned and unquestioned

groups disappears. In addition, Carver (1972) expresses scepticism about Rothkopf's (1965; 1966) claims that questioning influences the students' learning strategies. Carver suggests that students in Rothkopf's experiments really had two sets of instructions, one the general prescription to "learn all the material", and the other implicit in specific detailed questions to "learn these specific details." Thus, Carver claims that the existence of the two kinds of instructions militates against Rothkopf's conclusion that it is the questions and not the general instruction which influences students processing.

Summary and Critique

Drawing conclusions on the basis of available evidence regarding the utility of questions in text is made difficult by a number of methodological problems. First, as with organizers and objectives, the range of materials and procedures which have been used is extensive and rarely reported in sufficient detail to make meaningful comparisons. Second, there has been a tendency to draw conclusions about the existence of direct effects of questions on repeated test items without consideration of time as a contributing factor and without excluding the potential effect of general instructions to "learn all the material." The third problem in drawing conclusions from the literature is related to the claim for indirect effects of questions on new or irrelevant test items. Ladas' (1973) arguments and the lack of support from more recent literature makes the evidence for such effects tenuous.

A more generic problem associated with drawing conclusions about the utility of inserting questions in prose is related to the research strategies generally employed. The majority of research using adjunct questions has employed an intentional/incidental paradigm and as DeDecco

and Crawford (1974) point out:

In an incidental learning situation, the experimenter does not provide instructions which prepare students for a test on the materials they are to learn. The students can be given no instructions at all or they can be directed to learn one and be tested on another task. Intentional learning provides for the prior announcement of the test and the learning task. (1974, p. 225)

In general, the intentional/incidental paradigm which arranges conditions so students are told to learn one thing and tested on another is a means of studying learning processes. Instruction, on the other hand, is intended specifically to promote learning. The concern in an instructional paradigm is primarily with learning outcomes rather than learning processes. Instructionally, the intentional/incidental paradigm may be viewed as a means of evaluating how questioning specific details promotes the learning of those details and not other details rather than as a means of determining whether or how inserted questions improve learning from prose. In this study the intent is to examine the learning outcomes associated with the manipulations rather than to examine the learning processes which may be involved.

There are instructionally relevant and important questions to be asked in regard to the utility of inserting questions in text. These questions are related to issues such as type, location and frequency of questions which will support the students' meaningful processing activities in learning from prose.

The array of problems described above seems to make generalizations from research with adjunct questions difficult and possibly inapplicable to applied instruction. It should be remembered, however, that the evidence provided in Anderson and Biddle's (1975) review for a facilitation of post-questioning strategies on learning from prose cannot

be discounted. The possible contribution of this evidence in the preparation of prose instructional material will be discussed further in the following section of this paper.

An Instructional View of Adjunct Questions

In instructional contexts the use of questions inserted into text can be viewed as "practice", that is, an opportunity for the student to perform the expected behavior prior to the test situation. There are three ways in which instructional "practice" seems to differ from the research usage of inserted questions.

First, in research, the presence and location of the questions are often independent variables. In instructional procedures, questions as practice are almost always included and placed in a post-location. While there is some discussion of the necessity of including practice most instructionally prepared materials include such opportunity and assume that a learner who has no need for practice will simply omit it. (cf Merrill, 1975)

Second, in research, the inserted questions rarely include feedback while in instructional procedures practice with feedback is the norm. The role of feedback has received considerable attention (e.g., Tobias, 1973; Geis & Chapman, 1971) but the most common usage appears to be practice with feedback.

The third difference appears in terms of "consistency." Considerable effort is expended by instructional practitioners in maintaining a consistent relationship among objectives, questions, and test items. (cf Popham, 1973; Merrill, personal communication, 1976). Within research contexts, however, this issue is viewed rather as "identical" or "applied."

Specifically, instructional practitioners argue the importance of a relationship among objectives, questions and testing such that the behavior the learner is asked to perform, permitted to practice and subsequently tested upon, is consistent. In respect to textual information, for example, there are at least two dimensions along which objectives, practice and test items might be consistent or inconsistent. Objectives, questions and test items could be consistent or inconsistent in terms of the response type. To be consistent an objective which specifies multiple-choice response format should be accompanied by multiple-choice format practice and multiple-choice format testing. A second dimension along which inconsistency or consistency is possible is that of information level such as described by Bloom et al (1971). To be consistent in this dimension, objectives, questions and testing would all have to occur at the same taxonomic level.

The "consistency" argument derived from instructional practices differs from the theoretical arguments presented in the "mathamagenic" and "Levels of Processing" hypotheses in terms of the specification of type of question for various purposes. The "consistency" argument suggests that if the instructional intent is to produce "higher order" skills then the "higher order" skills should be practiced during the study period. If the intent is to produce factual information then the student should practice with factual information during the study period. There is no implicit assumption made that students who practice the "higher order" skills will automatically acquire those skills as well as related subordinate factual information. Rather, the assumption is made that the instructional developer will identify any necessary underlying factual information and explicitly provide for the practice of

that information if it is necessary to the acquisition of the "higher order" skill. The "mathamagenic" and "Levels of Processing" hypotheses, on the other hand, lead to a position which assumes that practice on a "higher order" skill will lead automatically to greater acquisition of specific underlying facts. There is some research support for this position (e.g., Frase, 1971; Rickards & DiVesta, 1974).

It is important to note that the positions described above represent views held by authors and theorists from divergent psychological traditions. The instructional tradition is essentially behavioristic in nature and makes no explicit assumptions about the characteristics of the learning processes within the student. Rather, the behaviorist approach can be characterized as suggesting that whatever behavior is desired has to be taught. The "mathamagenic" and "Levels of Processing" hypotheses arise from an essentially cognitive school of psychology and are concerned with making inferences about the characteristics of the internal state called learning. This approach is somewhat more sensitive to and interested in the unplanned effects which are associated with student's cognitive processes.

One specific comparison of questions used by researchers from the cognitive tradition (Anderson & Biddle, 1975) is the verbatim/paraphrase type. The argument they present suggests that a paraphrase question requires broader processing (both semantic context and lexical form) while verbatim questions require only the processing of the same lexical form. Then the insertion of verbatim items should lead to less learning than insertion of paraphrase items. Since the positions suggested by "consistency" and "mathamagenic" or "Levels of Processing" hypotheses lead to slightly different suggestions for the use of inserted questions

this research will attempt to examine empirically the effects produced using both positions.

In arranging objectives, questions and test items consistently, two dimensions will be considered, the item forms (open-ended or multiple-choice) and the question type (verbatim or paraphrase). Consistent conditions will be provided with objectives, practice questions and test questions which match both in terms of item form and question type. Inconsistent conditions will be arranged so that they meet as far as possible, the conditions which are suggested by the "mathamagenic" and "Levels of Processing" hypotheses. Specifically they will receive only paraphrase questions inserted in the text while they will be tested on both verbatim and paraphrase test items. All inserted items for these groups will be of an open-ended format, a type of question which, according to Anderson and Biddle (1975), leads to the largest direct effects. It should be noted that since this research deals with objectives as well as questions and since objectives are necessary in consistency arrangements, objectives will be present in the text of inconsistent groups. The typical research relating to adjunct questions (e.g., Rothkopf, 1970; Frase, 1970; Anderson, 1970) does not include objectives with questions. In order to retain comparability among groups the inconsistent questions groups will be provided with objectives which are consistent with the inserted questions. The inconsistency, therefore, is in reference only to the relationship between practice and test items.

In summary, there are four ways in which instructional practice appears to differ from research with adjunct questions. First, practice is almost always included and follows the relevant material--it is an integral part of instruction rather than something which is occasionally

inserted. Second, concern with the effects of practice is explicitly "intentional." That is, the intentional/incidental paradigm is not used. Third, feedback in some form is usually included. Fourth, practice must be consistent with both objectives and subsequent testing.

In this study, three of the four differences will be held constant. Practice will be used, an intentional paradigm will be employed and feedback will be included. Only one feature of practice will be manipulated, that is consistency.

In order to investigate the contribution of consistency to the effects of practice on performance scores, two arrangements will be used. First, an inconsistent condition will be established by inserting questions which differ from test items in terms of the two dimensions, form (open-ended and multiple-choice) and question type (verbatim and paraphrase). The second, consistency arrangement will involve inserted questions, objectives and test items which match on both dimensions. No inserted questions will be identical to test questions.

The Research Plan

Within the context of applied instruction, it is not uncommon to find several general prescriptions for learning from text. First, it is recommended that the student be provided with some information about where he is in the material, where he is going and where he has been. Second, it is suggested that the student be told what he is to do with the information he is given. Third, it is recommended that the student be given a chance to practice whatever it is that he is expected to do.

These three general prescriptions appear to correspond with the three manipulations organizers, objectives and questions. The use of these manipulations and the existence of the prescriptions is visible, not in

research literature but rather in instructional products (e.g., Courseware Inc., 1974).

This is a substantial deviation from the procedures which are followed in research using organizers, objectives and questions where each of these manipulations appears to be viewed as an alternate serving the same function. Rothkopf and Kaplan (1972) for example, view their objectives as essentially declarative forms of questions and both manipulations are seen as mechanisms to "maintain attention to text."

The issue of whether the three manipulations can be used as alternates or whether they are three different and important manipulations does not appear to have been investigated.

Each of the manipulations, organizers, objectives and questions has been prepared in two ways. The first, the way in which the manipulation is most commonly used in the research literature. The second, the way which seems to be most appropriate to instructional prescription and usage. All three manipulations, in one or the other form, will be included in each instructional package presented to the students in order to support learning from textual material.

An attempt is made, in this research, to include some methodological controls which may have contributed to the lack of conclusiveness in the research data previously cited. First, each of the manipulations used is described and presented with the rules used in its production or acquisition. Second, the presentation mode most frequently used with each manipulation is adopted for use here. Advance organizers are massed. Objectives are dispersed preceding the materials to be learned. While in some cases objectives have been presented in a list form preceding the instruction, one of the common current uses is in a dispersed mode

(cf Popham & Baker, 1970). Inserted questions with feedback are dispersed after the relevant textual materials. Third, time is controlled and identical for all students.

It is hoped that these controls, in conjunction with an instructional approach to the use of organizers, objectives and questions will provide information useful in the preparation of prose materials from which learning is improved. (cf Merrill & Boutwell, 1973)

The Research Question and Hypotheses

Improvements in learning from prose materials can be accomplished by means of "instruction" which, according to Gagné' (1974) is the arrangement of environmental conditions which support the learner's processing activities. Careful consideration of the research relating to three manipulations has led to the conclusion that the effectiveness of organizers, objectives and to a lesser extent, questions, in providing such support is equivocal.

Each of the three manipulations were considered in terms of current instructional precepts and procedures and then restructured to suit their use in applied contexts. It is hope that the use of these manipulations in their two different forms will lead to improved learning from prose.

In order to empirically determine the usefulness of these manipulations in improving learning from prose, an experiment has been conceived to explore one general question:

Are there differences in students' learning with organizers, objectives and questions as they are found in research when compared to organizers, objectives and questions developed from an instructional context?

From this general question four hypotheses have been derived for testing within an experimental design:

- H. 1: A prose organizer produced by Ausubel and Fitzgerald (1962) will lead to significantly lower performance scores than a graphic-word organizer.
- H. 2: Content-referenced objectives will lead to significantly lower performance scores than content-free objectives.
- H. 3: Inconsistency between inserted questions and test questions will lead to significantly lower performance scores than consistency between objectives, inserted and test questions.
- H. 4: The use of organizers, objectives and questions with text materials will lead to significantly higher performance scores than will occur with text alone or manipulations without text.

A fifth more general and exploratory hypothesis is added.

- H. 5: Some differences exist between performance scores of experimental and control groups on immediate and delayed testing.

CHAPTER II

Method

Materials Production

The material used in this research, with the exception of the basic text produced by Ausubel and Fitzgerald (1962), was produced by this author. A brief description of the plan and preparation of the materials follows.

Text

The prose material used is a slightly shortened version of the original text produced by Ausubel and Fitzgerald (1962). Shortening was done in response to students' difficulty in completing the material in the time available during a pilot study (approximately 2500 words).

This text was selected because: 1) It has been used previously in similar research (Ausubel & Fitzgerald, 1962; Papay, 1971); 2) Both cited authors suggest that it is comparable to university level texts; 3) The text is considered by the cited authors to be appropriately difficult and unfamiliar for research use.

The text was subdivided into 13 sections of approximately two paragraphs each. One section consisted of one long paragraph and two sections consisted of three short paragraphs. The sections were typed on white 8 1/2 x 11 sheets of paper with space left at the top for objectives and at the bottom for questions (see Appendix II).

Advance Organizers

Two types of organizers were used. The first, in Table 1 as level one, is a 450 word prose passage produced by Ausubel and Fitzgerald (1962) and is considered by them to be at a "higher level of generality and inclusiveness" than the accompanying text (see Appendix III).

The second type of organizer, the graphic-word organizer, is a one page visual-verbal combination produced by drawing the main idea from each paragraph of the original organizer and placing these main ideas in a hierarchical arrangement. Wherever possible a less technical term was used. These main ideas were then connected by a system of encircling lines and arrows to indicate relationships among the ideas (see Appendix III).

Instructional Objectives

Two types of objectives were prepared for this study. Content-referenced objectives are similar to objectives found in the research literature and variously designated "specific objectives", "behavioral objectives" or "performance objectives." They consist of statements directing students to learn specific information in the text (see Appendix IV).

Content-free objectives were prepared following the discussion on page 15ff. They direct the student to the relevant type of information, specific detail or several details combined, without including any statements drawn from the content of the text. In addition, they specify the type of response which will be expected, open-ended or multiple-choice (see Appendix IV).

Adjunct Questions

Questions for consistent groups were all multiple-choice items prepared according to the following two rules:

Verbatim Items:

One specific detail of information is taken from the prose such that the question stem and its correct alternative form a verbatim statement found in the text.

Paraphrase Items:

Two or more specific details found in non-adjacent text sentences are combined such that the stem and the correct alternative is a paraphrase non-identical to the sentences as they appeared in the text.

Six verbatim multiple-choice items and seven paraphrase multiple-choice items were prepared for insertion into appropriate text sections.

Questions for inconsistent groups were all open-ended paraphrase items prepared using the paraphrase rule. All inserted questions were placed on the bottom of the page of text to which they referred. Answers, in sentence form, were presented for all questions on the page immediately following the relevant text. Questions and answers are presented in Appendix V.

Achievement Tests

Twenty-six multiple-choice test items were prepared. Twelve of these items were verbatim questions for text sections which had received inserted verbatim items (consistency groups). Fourteen items were paraphrase items for the text sections which had received inserted paraphrase questions (both consistency and inconsistency groups). All test items were five alternative multiple-choice format. No test items were identical to inserted questions.

To provide for supervision and easier monitoring tests were prepared using different paper colors and different item orders for immediate testing. Different paper color and different ordering of both items and the alternatives were used for delayed testing.

Questionnaire

A short questionnaire asking students opinions and attitudes towards the research was prepared (see Appendix VII).

Subjects

The subjects were students registered for spring session classes in the Faculty of Education and students registered in "university level programs" at Grant MacEwan College. They were all volunteers with university experiences ranging from 1 to 4 years. There were approximately equal numbers of males and females. The total sample size was 132, 12 students in each of 11 groups.

Materials

Packages of materials for all groups were prepared prior to the first meeting with students. Each package contained:

- a) A general introduction (see Appendix VIII).
- b) Learning materials consisting of the appropriate combination of organizer, objectives, questions and text.
- c) An immediate post-test with machine scoreable IBM answer form.
- d) A questionnaire.

Procedures

All experimental sessions occurred during regular classroom time. A short introduction was presented verbally to the group (see Appendix VIII). A short pause was allowed for students to leave if they wished. The number of students opting to leave varied from 1% to 60% of the group. Randomly arranged packages of materials were then distributed to the students. In each group an attempt was made to ensure at least one package from every experimental and control group was distributed.

Students were asked to remove the white learning materials from their envelopes and told they had 35 minutes in which to study before they would be tested.

Time available was recorded on the blackboard every 5 minutes and

announced every 10 minutes. After the 35 minute study time had elapsed students were asked to mark on their materials where they stopped if they had not completed them. They were then asked to replace the study materials in the envelopes and to take out the test paper and answer form.

Students were told they had 20 minutes in which to complete the test. After its completion they were to fill out the questionnaire and return all materials to the experimenter.

Ten groups of students ranging in size from 6 to 70 participated in the research in this fashion. After every session the experimenter examined each returned package. Thirty students were removed from the experiment for one or the other of the following reasons:

- a) failure to complete the study materials,
- b) failure to complete the test in the allotted time.

These deletions occurred approximately equally in all experimental and control groups.

Whenever a student's materials were removed from the experiment, a new package for the group in which they had participated was added to those not yet completed. In this way, equal numbers of students in each group was ensured.

Approximately one week after the initial session the experimenter returned to the classroom for delayed testing. At this time, the students were told that no forewarning had been given in order to prevent undue anxiety or outside study (see Appendix VIII). The students were then asked to write the delayed form of the achievement test.

After 12 students had worked through materials for each of the eleven groups, IBM answer sheets were checked for completeness. Double

marking or blanks were treated as errors.

The answer sheets were then submitted for machine scoring and card production. Two cards were produced for each student who had participated in both immediate and delayed testing. One card was produced for students who participated in immediate testing only.

Three scores were punched on each card:

- a) Subscore "V" - the number of correct responses on verbatim items (total of 12).
- b) Subscore "P" - the number of correct responses on paraphrase items (total of 14).
- c) Total score - the number of correct responses on all items (total of 26).

Research Design

A 2 x 2 x 2 factorial design was employed in which each factor, A (organizer), B (objectives) and C (questions), had two "levels." The levels represent the two forms of each manipulation. This design produced a factorial arrangement of eight groups. In addition, three "control" groups were added to the design. The "text only", "old manipulations only" and "new manipulations only" are described in Table 1 which presents the variables used in this study. A list and verbal descriptions of all experimental and control groups is presented in Appendix I.

Table 1

Variables Involved in This Study

Independent Variables	Levels	Dependent Variables
a A. Advance Organizer	1. A 450 word prose passage (Ausubel & Fitzgerald, 1962)	1. Achievement Test Scores.
	2. A one-page "graphic-word" organizer derived from the prose organizer as described on p. 31.	a) Total score obtained on 26 item achievement test.
		b) "v" scores - number of correct responses on verbatim items (12).
B. Instructional Objectives	1. "Content-referenced" objectives telling students what content to learn.	c) "p" scores - number of correct responses on paraphrase items (14).
	2. "Content-free" objectives telling students what <u>kind</u> of information to learn.	
C. Adjunct Questions with Correct Answers	1. "Inconsistent" items differed from all test items in terms of item form and from half the test items in terms of question type.	
	2. "Consistent" items - similar to objectives and test items in terms of item form and question type.	

a actual materials used are found in appendices

CHAPTER III

Results and Discussion

Several types of analyses were performed using the three dependent measures (verbatim (V), paraphrase (P), and Total scores). First, three-way analyses of variance were performed using the data from the eight experimental groups within the factorial design. Second, one-way analyses of variance were calculated using the eight experimental and three control groups. Third, two-way analyses of variance were performed upon the immediate and delayed test scores for both experimental and control groups. The results of these analyses will be presented individually and discussed in terms of their contributions to the research hypotheses. Since each type of analysis has some bearing on several hypotheses discussion will proceed in chronological order according to the hypotheses involved.

Throughout the discussion issues relating to the relative magnitude of scores will arise. Therefore, Table 2, providing means V, P and Total scores for all groups on immediate and delayed testing, is inserted here for continuing reference.

Hypothesis One

A prose organizer produced by Ausubel and Fitzgerald (1962) leads to significantly lower performance scores than a graphic-word organizer.

Tables 3, 4 and 5 present the results of three-way analyses of variance performed upon Verbatim, Paraphrase and Total scores for the eight experimental groups. Tables 3 and 5 indicate a significant main effect for organizers in the analyses upon V and Total scores, $F(1,88)=3.82$, $p<.05$; $F(1,88)=5.01$, $p<.05$. Results presented in Table 4

Table 2

Verbatim, Paraphrase and Total Score Means for Experimental Control
Groups on Immediate and Delayed Testing

	EXPERIMENTAL GROUPS								CONTROL GROUPS		
	Prose Organizers				Graphic-Word Organizers				Text	Old Manipulation Only	New Manipulation Only
	Content-Referenced Objectives		Content-Free Objectives		Content-Referenced Objectives		Content-Free Objectives				
	In-consistent Questions	Consistent Questions	In-consistent Questions	Consistent Questions	In-consistent Questions	Consistent Questions	In-consistent Questions	Consistent Questions			
^a Immediate Means											
b _v	7.00	6.08	6.33	6.50	6.08	5.42	6.17	5.67	4.92	5.00	5.25
P	5.92	6.00	5.92	5.83	5.58	5.92	5.50	4.08	5.33	3.75	4.17
T	12.92	12.08	12.25	12.33	11.66	11.34	11.67	9.75	10.25	8.75	9.42
Delayed Means											
b _v	6.11 ^c	6.78	5.00	5.78	5.20	5.60	6.00	4.91	6.20	4.40	6.00
P	5.33	5.11	4.33	4.78	5.10	4.20	4.10	4.73	4.60	4.90	4.50
T	11.44	11.89	9.33	10.56	10.30	9.80	10.10	9.64	10.80	9.30	10.50

^a n = 12 per cell

b_v = verbatim items, P = paraphrase items, T = Total scores

^c delayed testing groups all have unequal n's. n = 12

Table 3

Analysis of Variance of Verbatim Scores
for Eight Experimental Groups

Source	SS	MS	df	F-Ratio	Probability
A (organizers)	10.01	10.01	1	3.82	.05
B (objectives)	.01	.01	1	.04	NS
A x B	.51	.51	1	.20	NS
C (questions)	5.51	5.51	1	2.10	NS
B x C	2.34	2.34	1	.89	NS
A x C	.26	.26	1	.10	NS
A x B x C	1.26	1.26	1	.48	NS
Error	230.75	2.62	88		

Table 4

Analysis of Variance of Paraphrase Scores
for Eight Experimental Groups

Source	SS	MS	df	F-Ratio	Probability
A (organizers)	10.01	10.01	1	2.43	NS
B (objectives)	6.51	6.51	1	1.58	NS
A x B	4.59	4.59	1	1.12	NS
C (questions)	1.76	1.76	1	.43	NS
B x C	5.51	5.51	1	1.34	NS
A x C	1.76	1.76	1	.43	NS
A x B x C	3.76	3.76	1	.91	NS
Error	363.25	4.13	88		

Table 5

Analysis of Variance of Total Scores
for Eight Experimental Groups

Source	SS	MS	df	F-Ratio	Probability
A (organizers)	40.04	40.04	1	5.01	.05
B (objectives)	6.00	6.00	1	.75	NS
A x B	2.04	2.04	1	.26	NS
C (questions)	13.50	13.50	1	1.69	NS
B x C	.67	.67	1	.10	NS
A x C	3.38	3.38	1	.42	NS
A x B x C	9.38	9.38	1	1.17	NS
Error	703.03	7.99	88		

indicate there were no significant main or interactive effects for organizers on P scores. These results reverse hypothesis one by indicating a superiority of the prose over the graphic-word organizer.

These data represent a reversal of the predicted differences. In the discussion (p. 8 ff) it was argued the graphic-word organizer should lead to better learning than the prose organizer. This expectation was based upon the applied experiences of groups such as Courseware Inc. and the logical argument that students would be better able to use a manipulation which was more parsimonious and less technical. Support for this position was also drawn from research reported by Barron and Stone (1974). There is, however, one way in which Barron and Stone (1974) used graphic-word organizers which differs from the use in this study. Their students participated in its production, either with the experimenter or with other students. This difference was noted at the outset but no information was available to indicate the relative importance of this "interactive" component in learning from prose material. The possibility that "student generated" organizers may be more effective than "author generated" organizers has also been discussed by Dooling and Mullet (1973). Lack of student participation or interaction, therefore, may have contributed to the relatively poor performance of the graphic-word organizer. Wittrock (1974) discusses the importance of the learner's role in interpreting and processing of stimuli and draws attention to the importance of the learner's previous experiences. This factor cannot account for the relative effectiveness of the prose organizer since it too was "author generated." It is necessary to look elsewhere for an explanation which will account for this superiority of the prose over the graphic-word organizer. Such an explanation may be

found in considering relative familiarity and ability of students with verbal as compared to visual information. Holliday (1976) examined the effects of pictorial, block-word, and prose presentations with high school students learning verbal chains. He found that students could, when no alternatives were presented, gain information from all three presentation modes. But when pictorial or block-word formats were presented in conjunction with prose materials the students showed a marked tendency to prefer the verbal to the visual information source. In discussing these results Holliday (1976) suggests that students' previous learning experiences have trained them to prefer prose over visuals as information sources.

That students may be unable to extract meaning from the visual component of the graphic-word organizer is consistent with Salomon's (1974) suggestion that there are differences in symbolic codes in different media. In this case, the verbal code implicit in the prose organizer is one with which students have some familiarity while the visual code in the graphic-word organizer was probably relatively unfamiliar. Since this particular visual was unlikely to be "image producing" in its effect, it is possible that it had an interfering effect on the usual contiguous sequential encoding of the verbal material.

This is a particularly important issue for instructional practice since the question of what visuals to use and how to use them is a common problem. The evidence from this research is consistent with Holliday's (1976) results and warrants further investigation. This issue may be one for which the use of an Aptitude-Treatment-Interaction (ATI) framework is most appropriate. Disordinal interactions have been demonstrated in an aural/visual modality framework by Ingersoll and Divesta

(1972). The issue of ability to use verbally or visually presented information could, for example, be addressed through the use of students who are: (a) verbally skilled (e.g., English majors or students scoring high on measures of verbal fluency), and (b) visually skilled (e.g., Art majors or students scoring high on visual ability measures); providing such students with either verbal or visual presentations might permit the detection of an aptitude factor relevant to the preparation of instructional materials. In addition it seems possible to question whether students with one type of ability could be trained to use the other information source.

Summary

The data analysis provided evidence which does not support hypothesis one and is a reversal of the expected direction. The superiority of the prose over the graphic-word organizer was discussed in terms of the possibly important lack of interactive component of the latter and the possibly strong preference for and ability with the former. These results were noted as requiring special attention for instructional product developers.

Hypotheses Two and Three

Content-referenced objectives lead to significantly lower performance scores than content-free objectives.

Inconsistency between inserted questions and test questions leads to significantly lower performances than consistency between objectives, inserted questions and test questions.

Results presented in tables 3, 4 and 5, showing no significant main or interaction effects for objectives and questions, represents a failure to support hypotheses two and three. In addition, relatively small mean squares indicate very little variance attributable to objectives or

questions of either type.

These results are somewhat surprising since both objectives and inserted questions were found in the literature to have contributed substantially to performance scores in many experiments. The lack of significant effects for objectives and questions seems most plausibly explained in terms of the evidence for their lack of use.

The theoretical premises underlying the use of inserted manipulations in prose text are derived, in part, from discussions of the use of inserted questions and orienting stimuli generally. This position is presented by Kumar (1975) in which he describes the action of orienting stimuli as involving a two stage orienting response. Stage one is thought to be a brief phase involving gross motor responses while stage two is thought to be a more prolonged "tonic" phase involving scanning of details. The underlying assumption thus suggests that stimuli which elicit gross motor orientation plus the scanning for details should lead to improved performance in relation to the information scanned.

In his own research using out-of-context words and instructions to "note" or "remember", Kumar (1972) obtained relatively small differences in performance scores when compared to control group scores and no difference after 24 hours delayed testing. He discusses, in his explanation for these negative results, evidence from students that they often did notice the orienting stimuli and were aware, in the case of the "note" and "remember" stimuli, that they were expected to remember that information. The students, however, were in some cases explicit in their statements that they did not like memorizing or that there was too much information for the time given. Kumar (1975) thus concluded that while the orienting stimuli he used may have produced both stages of the

desired orienting response, that such a response may well be insufficient for performance scores to be enhanced. He suggests that in addition, the orienting response elicited may also need to be accompanied by the student's decision to retain the information given.

In this research there is also some evidence to suggest that the students may have noted and even scanned the information. Over 70% of the students reported on their post-test questionnaires that they had used "all" or "almost all" the manipulations presented to them. However, examination of their learning materials packages revealed that less than 30% of the students had marked anything on their packages beyond their names which were often pseudonyms. This may be taken as support of the argument that they did not form an intent to learn when it is viewed with the questionnaire evidence that over 70% of students said that when studying prose materials for learning they underlined, took notes, and answered questions.

The decision or intent to learn is, of course, viewed by most theorists and practitioners as important to the learning process and an essential component of motivation. However, it is also true that motivational variables are usually treated lightly or ignored in the kind of research cited in the literature review. Most often motivational variables are not explicitly discussed or addressed, but some evidence relating to motivational variables may be derived from the description of students. For example, it is not uncommon to find that students are drawn from classes where "course credit" is granted for participation in research and where participation in at least one research project is mandatory for all students. In some cases, however, students were encouraged by their classroom teacher to participate and in other cases

the classroom teacher was present at the beginning of the study. While most students appeared to be trying to study the materials and were cooperative, some did leave before and during the study time and a few expressed negative feelings towards the research being conducted during classroom time in a course which was very short and intense. It is not possible to draw firm conclusions relative to motivational states of students participating in this research; however, it seems reasonable to assume their motivational levels were similar to those in similar research contexts. This assumption is supported by the low average scores obtained by students in this research, ranging from 30% - 50%, which are comparable to scores obtained by Papay (1971) with similar materials.

A differential effect of this hypothesized motivational state on objectives and questions in comparison with organizers could be related to the fact that organizers appeared in an initial massed position while both objectives and questions were distributed throughout the learning passage with objectives preceding and questions following the relevant text passages. It seems likely, that if motivational factors were involved they would have greater impact on the manipulations which were experienced over a relatively long period of time (35 minutes) than the manipulation which was experienced within the first few minutes.

The relatively small effects of objectives and questions makes consideration of the hypotheses two and three speculative. However, it is possible to consider the trends which appear in the data. Figure 1 presents the total score means for groups using the two types of organizers, objectives and questions.

While the magnitude of the differences between the two types of

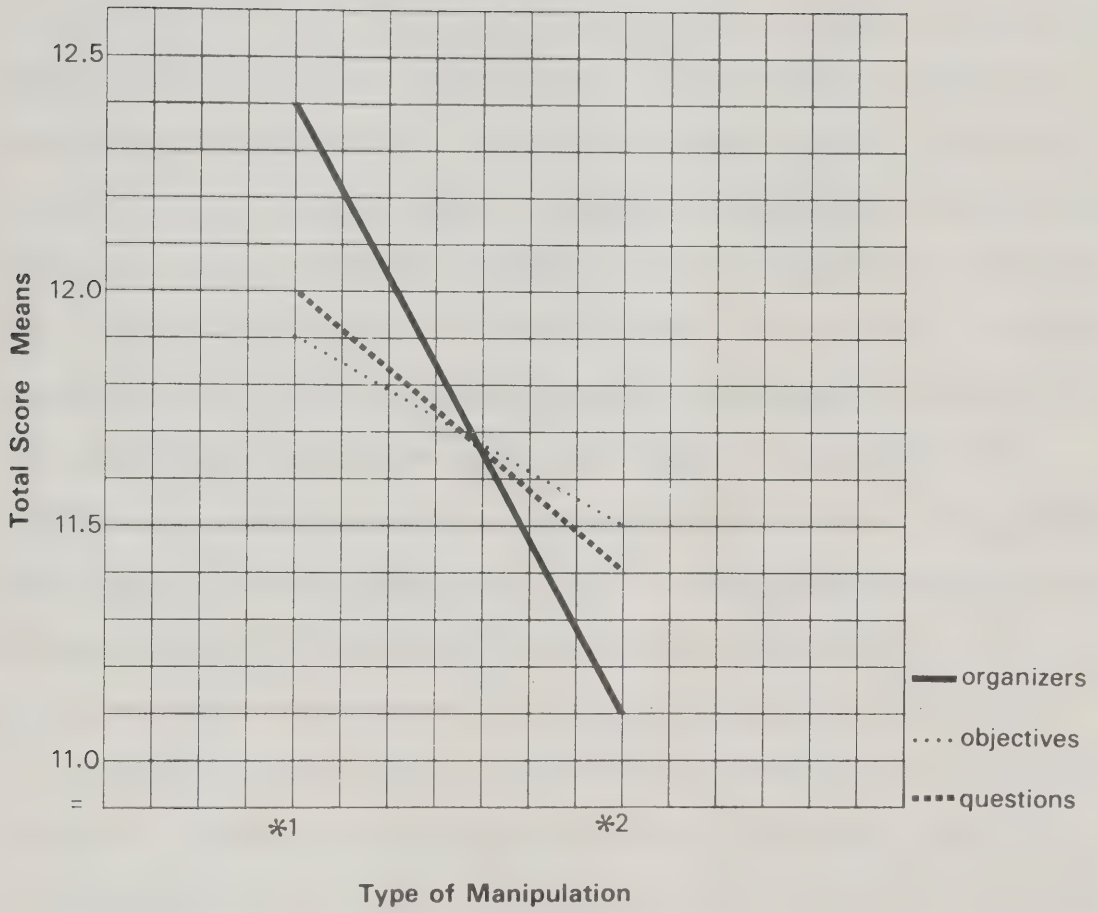


Figure 1 Total Score means obtained by groups using two types* of organizers, objectives and questions.

*1 prose organizer
content referenced objectives
inconsistent questions

*2 graphic-word organizer
content-free objectives
consistent questions

manipulations is small, it is also obvious that one type (the "common usage" version) is always better than the other type. In the case of organizers, the difference is significant. The direction of this pattern is the reverse of initial expectations and is so consistent that it seems to require further consideration. In each case, one type of manipulation was based on common usage in the literature while the other type was drawn from applied contexts. Since instructional products development is currently more characteristic of business and industry than education, if students had any previous experience with the manipulations it would have been in the traditional or research form. The relevance of previous experience with objectives was mentioned in the literature review. In addition, Bassett and Kibler (1975) have recently demonstrated that training in the use of objectives can improve performance. The marginal superiority of content-referenced objectives over content-free objectives may indicate that students given content-referenced objectives did know how to use them while students given content-free objectives did not.

A similar argument cannot account for the tendency for inconsistent questions to exceed consistent questions since the students would not have been aware of the dimensions along which the items were consistent or inconsistent and there is no a priori reason to assume more experience with open-ended than multiple-choice type items. While there is no statistically significant support, the trends in the data tend to favor the "mathamagenic" and "Level of Processing" hypotheses since the inconsistent questions should have lead to greater processing activities on the part of the students. A "Level of Processing" hypothesis would predict that the more active task would lead to deeper processing and subsequent improvement in performance. (Craik & Lockhart, 1972;

Mistler-Lachman, 1974). This explanation is particularly plausible when it is remembered that while the inconsistent items were inconsistent at the "micro" level, that is, in terms of the specific test questions, they were consistent at a "molar" level in that they were drawn directly from the paragraphs to be tested.

It remains, however, for subsequent research in which "real" students and "real" materials are used and in which some "intent to learn" can be established to determine whether the trends visible in this data would become significant or indeed reverse themselves as was hypothesized.

Summary

The lack of evidence to support hypotheses two and three was discussed in terms of the lack of evidence that either objectives or questions were used by students. The slight trends in the data which, tended to reverse expectations were noted and discussed. Possible explanations in terms of relative familiarity and depth of processing were suggested.

Hypothesis Four

The use of organizers, objectives and questions with text materials will lead to significantly higher performance scores than will occur with text alone or manipulations without text.

Since the initial analyses demonstrated significant main effects only for organizers it was decided to collapse across this variable for analyses of experimental and control group effects. The four experimental groups receiving prose organizers were, therefore, combined into one large group (Prose) while the four groups receiving the graphic-word organizer were combined into another single group (G-W). Subsequent analyses were performed with random samples drawn from these two larger groups in order to avoid the problems of unequal "n" and non-homogeneity

of variance.

The analysis presented in Table 6 is based upon Verbatim, Paraphrase and Total scores for 12 students randomly drawn from the "Prose" group and 12 students from the "G-W" group as well as the 12 students in control group "old manipulations only." Significant differences were found in the analyses based on P and Total scores, $F(2,33)=7.06$, $p<.005$; $F(2,33)=7.02$, $p<.005$. Table 7 presents the results of analyses using "Prose", "G-W", and "text only" groups with significance obtained in the analyses using P and Total scores, $F(2,33)=3.53$, $p<.05$; $F(2,33)=4.26$, $p<.05$. Table 8 presents the results of the analyses using "Prose", "G-W", and "new manipulations only" groups with significant effects from the analysis upon Total scores, $F(2,33)=4.59$, $p<.05$.

The results presented in Tables 6, 7, and 8 provide partial support for hypothesis four. In addition, from those results it can be argued that organizers, objectives and questions combined with this particular text lead to improvements essentially on paraphrase questions without showing marked effects on verbatim questions.

Table 9 presents a Newman-Keuls comparison of the means of the "Prose", "G-W", and control groups involved in the preceding analyses. Significant differences were found between the Total score means of "Prose" groups and the means of all three control groups.

From the above results it can be concluded that some experimental groups achieved higher total scores than the control groups. This seems to have been a result of somewhat greater scores on the paraphrase rather than the verbatim items. This support of hypothesis four should be viewed with reference to Carver's (1972) argument that if all students are given equal time to study the material, students with text alone will perform as

Table 6

Analyses of Variance of Verbatim,
Paraphrase and Total Scores
for Two Experimental Groups and One Control Group^a

Scores	Source	SS	MS	df	F-Ratio	Probability
V	Groups	16.89	8.44	2	2.17	NS
	Error	128.67	3.90	33		
	Chi Squared = 3.58, p=.17					
P	Groups	37.72	18.86	2	7.06	.005
	Error	88.17	2.67	33		
	Chi Squared = 2.74, p=.25					
Total	Groups	104.16	52.08	2	7.02	.005
	Error	244.84	7.42	33		
	Chi Squared = 2.79, p=.25					

^a Students were drawn randomly, 12 from each of the "Prose" and "G-W" groups.
Control group was - traditional manipulations only.

Table 7

Analyses of Variance of Verbatim,
Paraphrase and Total Scores
for Two Experimental Groups and One Control Group^a

Scores	Source	SS	MS	df	F-Ratio	Probability
V	Groups	18.06	9.03	2	2.28	NS
	Error	130.50	3.95	33		
	b Chi Squared = 9.80, p=.007*					
P	Groups	20.39	10.19	2	3.53	.05
	Error	95.25	2.89	33		
	Chi Squared = 1.81, p=.41					
Total	Groups	76.22	38.11	2	4.26	.05
	Error	295.42	8.95	33		
	Chi Squared = 4.71, p = .10					

^a Students were drawn randomly, 12 from each of the "Prose" and "G-W" groups.
Control group was - text only.

^b Chi Squared test of homogeneity of variance.

Table 8

Analyses of Variance of Verbatim,
Paraphrase and Total Scores
for Two Experimental Groups and One Control Group^a

Scores	Source	SS	MS	df	F-Ratio	Probability
V	Groups	11.72	5.86	2	2.19	NS
	Error	88.17	2.67	33		
	b Chi Squared = .14, p =.93					
P	Groups	21.17	10.58	2	2.97	NS
	Error	117.58	3.56	33		
	Chi Squared = 3.40, p = .18					
Total	Groups	64.39	32.19	2	4.59	.05
	Error	231.25	7.01	33		
	Chi Squared = 2.35, p = .31					

^a Students were drawn randomly, 12 from each of the "Prose" and "G-W" groups.

Control group was - new manipulations only.

^b Chi Squared test of homogeneity of variance.

Table 9

Newman-Keuls Comparison of Differences Between Means
on P and Total Scores
for Two Experimental and Three Control Groups

Groups	Differences	Critical Values
Prose: G-W: Old Manipulations Only		
P Score Means		
Prose: Old Manipulations Only	2.50*	1.65
G-W: Old Manipulations Only	NS	
Total Score Means		
Prose: Old Manipulations Only	4.17*	2.74
G-W: Old Manipulations Only	NS	
Prose: G-W: Text Only		
P Score Means		
Prose: Text Only	1.83*	1.71
G-W: Text Only	NS	
Total Score Means		
Prose: Text Only	3.50*	3.01
G-W: Text Only	NS	
Prose: G-W: New Manipulations Only		
P Score Means		
Prose: New Manipulations Only	1.67	1.90
G-W: New Manipulations Only	NS	
Total Score Means		
Prose: New Manipulations Only	2.92*	2.67
G-W: New Manipulations Only	NS	

* $p < .05$

well as students with text and questions. Since equal time was available to groups with manipulations (experimental) and the group with text only this data does not support Carver's argument.

It should be noted that Carver's argument involved the idea of "learning efficiency" and the small magnitude of difference scores obtained requires additional evidence to support or refute his position. Specifically, the question of relative efficiency of time spent is probably considered more usefully in the context of "meaningful" rather than "significant" differences. It would be useful, for example, to reconsider the question of level of performance with the use of instructional manipulations as compared to performance scores in the absence of the manipulations, in a more realistic context. In this research, the potentially critical motivational factors may not have been available because of the "experimental" nature of the research. In some respects, however, the research was a closer approximation of "normal" study contexts than is true of the research Carver (1972) was criticizing. Specifically, Carver addressed himself to papers by Rothkopf (1965; 1966) and Frase et al (1970) in which students were permitted to read one page at a time and not allowed to return or reread any of the material. In this study, students were given, and indeed took the option to read through and return or reread at their discretion. There were, of course, individual differences in the extent to which students exercised this option. However, the availability of the option to reread makes the study more naturalistic and in this respect the results could be viewed as evidence against Carver's position.

In addition, the relatively low scores in all groups may be accounted for in terms of the time permitted. Thirty-five minutes may not have been

sufficient for students in some groups to read the organizer and the passage. During the data gathering phase it was observed, for example, that some students appeared to finish and simply sit until the study time had elapsed. Many of these students were in the text only control groups. Only rarely was an experimental group student observed to stop working before the study time had elapsed. It may be that with more time available students with manipulations in text would, indeed, have shown greater improvements in scores because of "time" spent with the materials. It is possible that one of the effects of providing students with instructional manipulations is to ensure their prolonged involvement in the task. It is also possible that no amount of inducement will keep students with "text only" reading that text, thus regardless of amount of time provided students who have text only may simply stop studying. Additional research in which shorter materials or longer time was available and "text only" students were provided with some external inducements such as instructions to "keep studying" might demonstrate this effect.

Summary

The relatively substantial support provided for hypothesis four was discussed and additional relevant issues considered. A number of issues relating to the larger problem of increasing learning efficiency were described and suggestions were made about additional research which may address these issues.

Hypothesis Five

Some differences will occur between performance scores of experimental and control groups on immediate and delayed testing.

No a priori reasons exist for the expectation that the experimental

manipulations themselves might produce differences in short and long term retention. The question asked is exploratory. Since not all of the students in the initial sample were available for delayed testing, only students for whom both test forms were available were used in these analyses. This necessitated analyses using an unequal n's approach (Winer, 1971). Table 10 presents the results of analyses of variances using Verbatim, Paraphrase and Total scores for the 102 students participating in both immediate and delayed testing.

These analyses show no significant effects due to groups but show a significant effect due to time of test in the analyses based on P and Total scores, $F(1,91)=6.35$, $p<.01$; $F(1,91)=6.81$, $p<.01$. This difference represents a significant decrease in P scores from immediate to delayed testing. Diminution of the more complex item scores after a one week delay seems consistent with the verbal learning literature which shows lower retention for more abstract or difficult material (cf. Hall, 1971).

Table 10

Analyses of Variance with Repeated Measures of
Verbatim, Paraphrase and Total Scores
for all Experimental and Control Groups

Scores	Source	SS	MS	df	f-Ratio	Probability
V	Between Subjects	573.73		101		
	A (Group) Effects	59.34	5.93	10	1.06	NS
	Subjects within					
	Groups	511.25	5.62	91		
	Within Subjects	215.50		102		
	B (Test) Effects	3.11	3.31	1	1.58	NS
	A x B Interaction	20.05	2.01	10	.96	NS
	B x Subjects within					
	Groups	190.60	2.09	91		
P	Between Subjects	502.51		101		
	A (Group) Effects	37.32	3.73	10	.74	
	Subjects within					
	Groups	461.95	5.08	91		
	Within Subjects	253.00		102		
	B (Test) Effects	14.14	14.14	1	6.35	.01
	A x B Interaction	36.74	3.67	10	1.65	NS
	B x Subjects within					
	Groups	202.77	2.23	91		
Total	Between Subjects	1415.44		101		
	A (Group) Effects	171.47	17.15	10	1.27	NS
	Subjects within					
	Groups	1232.48	13.54	91		
	Within Subjects	502.50		102		
	B (Test) Effects	31.16	31.16	1	6.81	.01
	A x B Interaction	52.78	5.28	10	1.15	NS
	B x Subjects within					
	Groups	416.13	4.57	91		

CHAPTER IV

Conclusions and Implications

In summary, hypothesis four, predicting superiority of experimental over control group scores received some support. Hypothesis one, predicting the superiority of the graphic-word organizer over the prose organizer was reversed and the effects were statistically significant. Hypotheses two and three predicting differences between the two forms of objectives and the two arrangements of questions did not receive statistical support. The lack of statistical support obtained can be viewed as drawing attention to several important issues relevant both to further research and instructional practice.

This research was conducted with the knowledge that experimental conditions are not conducive to optimal student motivation. It was assumed that in using three manipulations, all of which have previously demonstrated significant effects in experimental research, adverse motivational effects would not be so overwhelming. Post hoc analysis and examination of students' study materials now makes this assumption suspect. Kumar's (1975) discussion of evidence which suggests that students were aware of the implications of "note" and "remember" comments yet they chose not to learn the material, implies a similar problem. Both this and Kumar's research have important implications for research using instructional variables.

First, evidence that students have used the manipulations in the form of underlining, or answers to questions could provide an indicator of intent to learn. Similar to performance scores as evidence for learning, such indicators would naturally be inferential and indirect.

It seems important to find mechanisms both to induce such decisions to learn and to provide evidence that they have been made. The use of students who enter the research situation with an expressed desire to learn information or skills should ensure initial motivational levels adequate to learning, while the provision of some external response should provide an indication that a decision has been made to learn the material under consideration.

Second, it should be noted that the instructional contexts from which the revised forms of the manipulations and the hypotheses were drawn tend to be characterized by the use of such students, i.e., those who enter the situation with a desire to learn the material. Further, the materials are produced within a developmental-recursive system in which students are presented materials, respond to them and revisions are made on the basis of their responses. It may be a flaw in this research, common to other experimental research, that students were provided with materials but no special effort was made to ensure that they used the materials. The relatively high scores obtained by "manipulations only" control groups in respect to the experimental groups is evidence that it was possible to learn from them. Within this research it seems that while the manipulations may "provide support for the students' learning processes", they did not do so very effectively. This lack of effectiveness may be related to the lack of use rather than inadequacies of the manipulations themselves.

In the literature reviews, it was pointed out that each of the three manipulations, organizers, objectives and questions, was associated with both supportive and non-supportive evidence with respect to improving learning from text. The inconclusiveness of the research was thought to

be associated with various methodological difficulties such as lack of operationalization, failure to control time and lack of consistency in presentation mode.

In this research, it is suggested that the use of these manipulations in an experimental context may have obscured some of the critical features which may emerge when they are considered in an instructional context. While some information was obtained in this research relative to the effectiveness and ineffectiveness of the various manipulations, it was suggested that this information may lack external validity in terms of instructional uses. Thus, while the issues addressed by this research may be important to the production of instructional prose, not ensuring adequate initial motivation and not providing evidence of "intent to learn" may have resulted in an inadequate evaluation relative to the use of these manipulations in a "real life" context.

It seems reasonable to conclude, from this research, that while all three manipulations may have a useful function in instructional prose, only the prose organizer made a significant contribution. This finding is of special interest because of its potential application to prose instruction. Among the many "rules of thumb" found in applied instructional contexts is that which recommends interspersed visuals. In this case, the visual-verbal combination in the graphic-word organizer resulted in significantly less learning. While it is possible that this effect is a product of the particular experimental materials it is important that this issue receive additional attention, particularly in a more realistic context which ensures students' intent to learn.

The data analyses demonstrating superiority of most experimental groups over control groups does allow the conclusion that when time is

controlled, experimental groups will perform better than control groups. This conclusion should be considered with respect to relative "efficiency" of learning and also "efficiency" of materials development. While Carver's (1972) argument relating to "time" has been considered and does not receive support, the small magnitude of differences between experimental and control group scores should be noted. Such differences, even though significant, can not be used as compelling argument to support the preparations of organizers, objectives and questions for instructional prose. Indeed, the magnitude of the differences does not exceed those obtained by Papay (1971) with single manipulations. This suggests that the assumption that all three manipulations are necessary in instructional prose requires consideration. It is possible that any one of the manipulations alone is sufficient to provide support for the students' learning processes and that including all three at most allows for "learner control" (Merril, 1975) i.e., for the student to select the instructional support most appropriate to his/her own needs. This possibility is one which does not appear to have received direct attention in the literature and is one which may provide useful information.

The major results of this research may be the attention drawn to students' entering motivation and intention towards the materials as a critical condition in attempting to investigate instructional variables within an experimental context. The suggestion drawn from these results is that while organizers, objectives and questions may be necessary "external events" to provide support for the students' learning processes, without appropriate entry motivational levels and external evidence of an intent to learn, they may not be sufficient conditions to promote learning.

It is felt that the attention to variables which influence internal validity (cf. Campbell & Stanley, 1963), such as novel materials, random assignment and experimental groupings may have severely limited the external validity of this research. Therefore, it is suggested that additional research involving these manipulations be conducted in two ways. First, research within a "real life" instructional context where the manipulations can be modified and improved until there is some reason to feel confident of their appropriateness to the particular learning materials should be conducted. Second, it is suggested that experimental research with these manipulations be conducted under less obtrusive conditions.

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APPENDIX I

List of Experimental and Control Groups

Experimental Groups

1. Prose organizer, inconsistent questions, content-referenced objectives and text (111).
2. Prose organizer, inconsistent questions, content-free objectives and text (112).
3. Prose organizer, consistent questions, content-referenced objectives and text (121).
4. Prose organizer, consistent questions, content-free objectives and text (122).
5. Graphic-word organizer, inconsistent questions, content-referenced objectives and text (211).
6. Graphic-word organizer, inconsistent questions, content-free objectives and text (212).
7. Graphic-word organizer, consistent questions, content-referenced objectives and text (221).
8. Graphic-word organizer, consistent questions, content-free objectives and text (222).

Control Groups

9. Prose organizer, inconsistent questions, content-referenced objectives with no text.
10. Graphic-word organizer, consistent questions, content-free objectives with no text.
11. Text only with no organizer, objectives or questions.

APPENDIX II

Text

Section 1

The Endocrinology of Pubescence

Pubescence refers to a characteristic group of bodily changes associated with sexual maturation. These bodily changes do not begin simultaneously but tend, rather, to follow each other in a definite order which is identical for all persons in a given sex group. This sequence is the same irrespective of the age at which pubescence occurs--even in instances of pathologically early or pathologically late puberty. It is also similar in all races, cultures and climates.

Just as long as the environment is sufficiently favorable to sustain life during the adolescent years, the bodily changes of pubescence invariably take place in the same order. In boys, for example, the first pubescent change is growth of the testes, followed by the appearance of pubic hair, by voice changes, and by the full development of facial hair. Enlargement of the breasts is the first indication of female pubescence. It is followed by pubic hair and the first menstruation.

Section 2

Initiation of Pubescence

Prepubescent boys and girls are not asexual biochemically. Sex hormones are found in the blood stream during childhood, but in insufficient quantities to result in primary and secondary sex characteristic-. These hormones are produced by the adrenal cortex under the stimulating influence of the corticotropic hormone of the anterior pituitary gland. The adrenal cortex produces both male (androgenic) and female (estrogenic) hormones, about the same quantity of each in both sexes. Hence there is no significant difference between prepubescent boys and girls in

androgenic-estrogenic ratio.

Pubescence is initiated by several important endocrinological changes. First, the concentration of the sex hormones (both androgens and estrogens) rises markedly and stimulates the development of primary and secondary sex characteristics. This change reflects in part the increased stimulation of the adrenal cortex by the corticotropic hormone. In each sex, therefore, the adrenal cortex produces both more androgens and more estrogens during pubescence than during childhood. Even more important, however, in raising the level of sex hormones is the fact that the gonads (testes in male, ovaries in female) begin secreting sex hormones for the first time. Such secretion first becomes possible during pubescence because the gonad-stimulating hormones of the anterior pituitary gland (the gonadotropic hormones) first become functional and stimulate gonadal secretion at this time.

Second, since the testes only secrete androgens and the ovaries only secrete estrogens, pubescent boys and girls are no longer undifferentiated with respect to the kind of sex hormone they produce. Boys produce more androgens than estrogens, and girls produce more estrogens than androgens. Still a third important factor promoting the initiation of pubescence is an increase in tissue responsiveness to hormonal stimulation. The various tissues involved in the primary and secondary sex characteristics become more responsive than previously to gonadal stimulation, and the gonads themselves become more responsive to gonadotropic stimulation.

Section 3

Primary and Secondary Sex Characteristics

One major group of pubescent changes occurs only within a given sex. These are the primary sex characteristics, and involve both the internal and external organs of reproduction and copulation. The second major category of pubescent development (i.e., the secondary sex characteristics) occurs in both sexes. Some of the latter, such as the growth of axillary and pubic hair and the increased activity of the sweat glands, are practically identical in the two sexes. Other secondary sex characteristics, however, such as breast development, facial hair, deepening of the voice, and the attributes of male and female body form are much more pronounced in one sex than in the other.

Primary and secondary sex characteristics manifest both normal and pathological degrees of variability. Only one type of variability is possible with regard to the primary sex characteristics: An individual may be more or less well-developed with respect to those organs characteristic of his sex group. Secondary sex characteristics, however, vary on two separate dimensions: First, an individual may be more or less well-developed with respect to sex-appropriate secondary sex characteristics (e.g., breasts in female; facial hair in male). Second, he may also be more or less well-developed with respect to sex-inappropriate secondary sex characteristics (e.g., facial hair in female; breasts in male).

Section 4

Normal Overlapping Between the Sexes in Sex Characteristics

It is apparent, therefore, that varying degrees of overlapping ordinarily prevail between the sexes with respect to the different sex

characteristics. Secondary sex characteristics are, by definition, found in both sexes. In those instances where they are undifferentiated with respect to sex (e.g., axillary hair), the overlapping is complete: no differences between the two sexes exist. In other instances, however, where secondary sex characteristics are normally more pronounced in one sex group than in the other, overlapping only occurs at the extremes of the distribution, i.e., where variation is extreme enough to be considered pathological. This situation is illustrated when a given sex-appropriate characteristic (e.g., breasts in female) happens to be both poorly developed in one sex (female, in this example) and, simultaneously, pathologically well-developed or sex-inappropriate in the opposite sex (male, in this example).

Primary sex characteristics, on the other hand, are, by definition, as well as in fact, distinctive of just a single sex group. Hermaphroditism, i.e., the occurrence of both male and female primary sex organs in one person, is an extremely rare genic accident.

Section 5

For all practical purposes, therefore, the development of either male or female primary sex organs in a given individual is one of the uniform or invariable attributes of pubescence. Individual differences in primary sex characteristics conform to the bell-shaped distribution curve--but only within a given sex, not between the two sexes. This type of "either-or" distribution of primary sex characteristics (i.e., the existence of two entirely separate, non-overlapping distributions of individual differences) is called "dichotomous." It contrasts sharply with the continuous, overlapping type of distribution found for the

secondary sex characteristics (i.e., the occurrence of individual differences between the sexes as well as within each sex group).

As pointed out above, depending on whether or not a particular secondary sex characteristic is or is not more distinctive of one sex than another (e.g., breast development as compared to axillary hair), overlapping will either occur in only extreme cases, or will be complete. By "overlapping" in this discussion, we mean overlapping degree of development of a given characteristic that crosses sex boundaries, and not simply the fact that all secondary sex characteristics are, more or less, represented in both sexes. Overlapping, in other words, is not exemplified by the fact that all males have rudimentary breasts and all females have some facial hair, but rather by the fact that some males have larger breasts than some females, and some females have more facial hair than some males.

Section 6

Hormonal Regulation of Primary and Secondary Sex Characteristics

Male and female sex hormones have either a selective or an unselective effect on the development of sex characteristics. They do not neutralize each other chemically. In the case of the primary sex organs and the sex-appropriate secondary sex characteristics, the action of sex hormones is selective. Male sex hormones, (androgens) for example, stimulate the growth of the testes and of facial hair, and tend to inhibit the growth of the female primary sex organs (e.g., uterus) and of female sex-appropriate secondary characteristics, and inhibit corresponding male characteristics. Thus, since the pubescent female normally produces more estrogens than androgens, her feminine sex characteristics (e.g., breasts, female body form) are more highly developed than her masculine sex

characteristics (e.g., facial hair, male body form).. The opposite situation obviously prevails in males. In the case of such undifferentiated secondary sex characteristics as the growth of axillary and pubic hair, the action of estrogens and androgens is unselective: male and female sex hormones have identical stimulating effects.

Differential hormonal effects, however, cannot explain the uniformity or invariability in the order in which the various primary and secondary sex characteristics emerge in a given sex group during pubescence. The same concentrations of the same sex hormones are equally accessible to all bodily tissues, and would therefore stimulate simultaneous development of all sex characteristics if the factor of differential tissue responsiveness were not operative. Hence, it is reasonable to assume that some tissues become responsive to the stimulating action of sex hormones earlier than do others, and that the order in which this responsiveness is acquired tends to be fixed or invariable within each sex group.

Section 7

Pathological Variations in Pubescent Development

Age of Pubescence

Pubescence normally takes place between the ages of ten and seventeen, with a mean of approximately 13.0 years in girls and of 14.5 years in boys. Within the normal range of variability, the age of pubescence reflects the age at which gonadotropic and gonadal hormones are secreted in functional quantities, as well as the age at which increased tissue responsiveness to the stimulating action of these hormones is acquired. Individual differences in these latter phenomena, in turn, are determined by hereditary differences (and hence are related

to age of pubescence in parents and siblings) and also by such environmental factors as climate, nutrition, and general health. Pubescence, for example, generally occurs earlier in temperate than in tropical or Arctic climates; and the earlier average age of pubescence in recent decades is largely attributable to improved standards of nutrition and general health.

Section 8

Precocious Puberty

Pathologically early (precocious) puberty, on the other hand, is almost always caused by excessive secretion of the adrenal cortex in young children or, more indirectly, by excessive secretion of corticotrophic hormone by the anterior pituitary gland, and hence overstimulation of the adrenal cortex. The underlying pathology is an overgrowth (hypertrophy) of gland tissue in either the adrenal cortex or anterior pituitary glands.

The kinds and sequence of pubescent changes in precocious puberty are identical in every respect to those occurring in normal puberty. The only difference is that they occur prematurely. The condition is treated most effectively by surgical removal of part of the hypertrophic gland involved (i.e. , adrenal cortex or anterior pituitary).

Section 9

Delayed Puberty

Pathologically delayed puberty generally reflects gross (extreme) insufficiency of gonadal production. This undersecretion may be caused by such destructive lesions of the ovaries or testes as bilateral cases of mumps, tuberculosis, and cancer involving these organs.

Destructive (atrophic) lesions of the anterior pituitary gland have the same retarding effect on the onset of pubescence as destructive lesions of the gonads. Under these conditions, insufficient gonadotropic hormones are secreted, and the inadequately stimulated gonads accordingly fail to produce adequate quantities of sex hormones. The occurrence of pubescence may also be abnormally delayed in instances of prolonged and severe malnutrition (at a near-starvation level), and in instances of extreme and protracted emotional trauma. Such cases are rarely observed under ordinary circumstances, but were not uncommonly encountered among teenage inmates of the concentration camps in Nazi Germany.

Pathologically delayed pubescence requires attention to the underlying cause. This may involve medical or surgical treatment of the gonadal or anterior pituitary lesion, on the one hand, or correction of malnutrition and/or emotional trauma, on the other. In any case, however, injections of large doses of appropriate sex hormone are of appreciable value.

Section 10

Pathological Variability in Primary and Secondary Sex Characteristics

Underdevelopment is the only kind of variability with respect to the primary sex organs which is medically and behaviorally significant. Where the cause is hormonal in origin, there is naturally a history of pathologically delayed pubescence, as well as generalized signs of inadequately developed primary and sex-appropriate secondary sex characteristics. Gonadal insufficiency in a male teenager, for example, would be manifested by undersized penis and testes, lack of body and facial hair, high-pitched voice, etc.

A much more common cause of underdeveloped primary sex organs,

however, is localized tissue under-responsiveness to normal hormonal stimulation. The gonads in this instance secrete normal amounts of sex hormones which induce normal development of all primary and secondary sex characteristics with the sole exception of the one hormonally under-responsive primary sex organ in question. The abnormality, therefore, is strictly localized to this one organ.

Section 11

Secondary Sex Characteristics

Pathological variability affecting the secondary sex characteristics is somewhat more complicated. Localized tissue under-responsiveness is again the most common cause of underdeveloped sex-appropriate secondary sex characteristics, giving rise, for example, to such isolated abnormalities as high-pitched voice in males and poorly developed breasts in females. In addition, however, localized over-responsiveness to opposite sex hormones is also a cause of significant abnormality insofar as the secondary sex characteristics are concerned. If the facial hair of a female happens to be over-responsive to androgens, she will grow a miniature beard. Similarly, if the breasts of a male happen to be over-responsive to estrogens, they will be unduly enlarged.

In both tissue under-responsiveness to sex-appropriate sex hormones and tissue over-responsiveness to opposite-sex hormones, the pathological secondary sex characteristics are localized, and all other primary and secondary sex characteristics are normal.

Section 12

Corresponding to the two kinds of pathological variability in secondary sex characteristics attributable to tissue under-responsiveness and over-responsiveness, respectively, are two parallel kinds of pathological

variability attributable to hormonal, and oversecretion of opposite-sex hormones. These abnormalities of hormonal origin are obviously much more generalized in the number and kinds of organs involved than the tissue responsiveness varieties.

Undersecretion of sex-appropriate gonadal hormones (e.g., androgens in males), due either to gonadal pathology or to pathology in the gonadal-stimulating portions of the anterior pituitary gland results in generalized underdevelopment of all sex-appropriate secondary sex characteristics (e.g., insufficient facial hair, high-pitched voice, etc.), as well as underdeveloped primary sex organs. The opposite-sex secondary sex characteristics, however, are normally developed.

Section 13

On the other hand, oversecretion of the adrenal cortex (due either to hypertrophy of the adrenal cortex or to overstimulation of the adrenal cortex by the anterior pituitary) results in generalized overdevelopment of opposite-sex secondary sex characteristics. In teenage girls, for example, excessive secretion of androgens by the adrenal cortex stimulates the overgrowth of body and facial hair, gives rise to low-pitched voice, etc. But in this instance, primary sex organs and sex-appropriate secondary sex characteristics are normally developed.

Both of these quite different but similarly general pictures of pathological pubescence caused by hormonal factors--gonadal undersecretion and adrenal cortex oversecretion--occur extremely rarely. Over- or under-responsiveness of just one particular tissue to normal hormonal stimulation--with a highly localized type of abnormality--is a much more commonly encountered cause of pathological variation.

APPENDIX III

Organizers

NOTE: This organizer represents the major ideas in the materials you will be reading. You might find it useful to examine it thoroughly before proceeding to the text.

The Control of Human Pubescence

Pubescence is a good example of biological change or development occurring during the life cycle of human beings. Like all other forms of cyclical biological change in individuals, pubescence is characterized both by uniformity (aspects of change that are similar in all human beings), and by variability (aspects of change that vary from one person to another). Uniformity in pubescence, for example, is illustrated by the fact that all persons of a given sex undergo the same kinds of pubescence bodily changes in the same orderly, predictable sequence. Variability in pubescence is illustrated by the fact that individuals differ from each other in the age at which they become pubescent and in the degree to which they manifest these same kinds of pubescent traits (e.g., size of breasts, amount of pubic hair). This variability tends to follow the bell-shaped distribution curve.

Thus there are some aspects of pubescence (i.e., kind and sequence of changes) in which all human beings of a given sex group develop in exactly the same way, and other aspects of pubescence (i.e., age of puberty, and degree of development) in which a normal range of variability exists. Considerable variability both in age of pubescence and in degree of development of the various pubescent changes is compatible with normality. At the very extremes of the bell-shaped distribution curve, however, variability is often pathological in nature.

The two most important sources of variability in pubescent traits are: (a) individual differences in hormonal output, and (b) individual differences in the responsiveness of particular tissues (e.g., sex organs,

breasts) to hormonal stimulation. Under- or oversecretion of a particular hormone results in generalized under- or overdevelopment of all the tissues stimulated by that hormone. Under- or over-responsiveness results in a strictly localized under- or overdevelopment of that particular tissue. Pathological variations in pubescent characteristics, also tend to be either generalized or localized in nature.

It is also possible to distinguish between two main types of pubescent abnormalities. An individual may be abnormal in the sense that he is deficient or underdeveloped with respect to a pubescent trait or traits appropriate for his sex group. A pubescent boy, for example, may be lacking in bodily and facial hair, and a pubescent girl may have atypically small breasts. This type of abnormality reflects undersecretion of the sex-appropriate sex hormone or under-responsiveness of the tissue in question to this hormone in the affected individual.

The extent to which variability in a pubescent characteristic is either restricted within a given sex group, or exhibits varying degrees of overlapping between the sexes, depends on whether the characteristic in question is a primary or secondary sex characteristic. This will be discussed in the following passage.

NOTE: This organizer represents the major ideas in the materials you will be reading. You might find it useful to examine it thoroughly before proceeding to the text.

PUBESCENCE: The biological changes which occur in people during sexual maturation.

CHARACTERIZED BY:

I. SAMENESS

All people of the same sex experience the same KINDS of changes in the same ORDER

II. DIFFERENCES

All people of the same sex differ somewhat in the AGE at which the changes begin and the DEGREE of change which occurs

CAUSES OF THE DIFFERENCES

Amount of Hormones Produced

Leads to a GENERALIZED EFFECT

Too much hormone

Too little hormone

OVERDEVELOPMENT

UNDERDEVELOPMENT

Tissue Sensitivity to Hormones

Leads to a LOCALIZED EFFECT

Under-sensitive to hormones

Over-sensitive to hormones

Tissue does not respond to OWN-SEX hormone

Tissue responds too much to OPPOSITE-SEX hormones

Extremes in these differences are called ABNORMALITIES

SEX-APPROPRIATE ABNORMALITIES

Too little OWN-SEX HORMONE

Tissue UNDER-SENSITIVE to own-sex hormone

UNDERDEVELOPMENT OF OWN-SEX CHARACTERISTICS

SEX-INAPPROPRIATE ABNORMALITIES

Too much OPPOSITE-SEX HORMONE

Tissue OVER-SENSITIVE TO opposite-sex hormone

OVERDEVELOPMENT OF OPPOSITE-SEX CHARACTERISTICS

APPENDIX IV

Objectives

Content-referenced Objectives

1. After reading this passage the student should be able to describe the factors which affect the order of pubescent changes in boys and girls.
2. After reading this passage the student should be able to name two hormones and their effects on the adrenal cortex and gonads.
3. After reading this passage the student should be able to describe the differences between the types of variability found in primary and secondary sex characteristics.
4. After reading this passage the student should be able to describe, using examples, the two types of distributions of secondary sex characteristics.
5. After reading this passage the student should be able to name the distribution patterns of primary and secondary sex characteristics.
6. After reading this passage the student should be able to describe the selective action of sex hormones in terms of primary and secondary sex characteristics.
7. After reading this passage the student should be able to describe the ways in which hormonal, tissue, hereditary and environmental factors influence the age of onset of pubescence.
8. After reading this passage the student should be able to describe the hormonal and organic causes of pathologically early pubescence.
9. After reading this passage the student should be able to describe the primary condition reflected by pathologically delayed pubescence and its causes.
10. After reading this passage the student should be able to describe the signs of the two types of pathological variability in primary sex characteristics.
11. After reading this passage the student should be able to give examples for boys and girls of a pathological condition which could be caused by tissue ~~under~~responsiveness to same-sex hormones.
12. After reading this passage the student should be able to describe the pathology that leads to underdevelopment of all sex-appropriate secondary sex characteristics.
13. After reading this passage the student should be able to describe the pathology that leads to overdevelopment of opposite-sex secondary characteristics and normal primary characteristics.

Content-free objectives

1. After reading the next passage of text you should be able to answer a multiple-choice type of question dealing with one specific piece of information.

This objective was inserted at the top of each section for which the practice question was of the "verbatim" multiple-choice type.

2. After reading the next passage of text you should be able to answer a multiple-choice type of question dealing with several specific pieces of information.

This objective was inserted at the top of each section for which the practice question was of the "paraphrase" multiple-choice type.

3. After reading the next passage of text you should be able to answer an open-ended type of question dealing with several specific pieces of information.

This objective was inserted at the top of each section for which the practice question was an open-ended type. All open-ended questions were "paraphrase".

APPENDIX V

Questions with Feedback

Inconsistent Questions

- Question 1. What factors do not affect the order of pubescent changes in either boys or girls?
- Answer 1. Factors such as age, race, climate and culture do not affect the order of pubescent changes in boys or girls.
- Question 2. What two hormones does the anterior pituitary produce during pubescence and what are the effects of these hormones on the adrenal cortex and gonads?
- Answer 2. The anterior pituitary produces corticotropic hormones which stimulate the adrenal cortex's production of androgen and estrogen. The anterior pituitary also produces gonodotropic hormones which stimulate the gonads to produce same-sex hormones.
- Question 3. What is the difference in types of variability found in primary and secondary sex characteristics?
- Answer 3. Primary sex characteristics can only be over- or under-developed while secondary sex characteristics may be over-developed in terms of opposite-sex characteristics and underdeveloped in terms of same-sex characteristics.
- Question 4. What are the two types of distribution of secondary sex characteristics? Give an example of each.
- Answer 4. Secondary sex characteristics such as axillary hair are distributed in an overlapping way while other characteristics such as facial hair are more characteristic of one sex group than the other and show overlapping only at the extremes.
- Question 5. What are the names of the distribution patterns of primary and secondary sex characteristics?
- Answer 5. The pattern of distribution of primary sex characteristics occurs in either one sex or the other and is called "dichotomous". The pattern of distribution of secondary sex characteristics is either equal in both sex groups or more pronounced in one group than the other and is called "continuous overlapping" or "overlapping at the extremes."
- Question 6. Describe the selective action of sex hormones in terms of primary and secondary sex characteristics.
- Answer 6. Sex hormones have a selectively stimulating effect on primary sex characteristics and sex-appropriate secondary characteristics. They have a selectively inhibiting effect on opposite-sex primary and secondary sex characteristics.

- Question 7. How do hormonal, tissue, hereditary and environmental factors determine the age of onset of pubescence?
- Answer 7. The age of onset of pubescence is determined by the age at which gonadotropic and gonadal hormones are secreted and the age at which increased tissue responsiveness occurs. The age of these events is determined by hereditary and environmental factors.
- Question 8. What are the hormonal and organic causes of pathologically early pubescence?
- Answer 8. Pathologically early pubescence might be caused by excessive secretions of androgen and estrogen by the adrenal cortex because of either hypertrophy of the adrenal cortex itself or hypertrophy of the cortex stimulating portion of the anterior pituitary.
- Question 9. What is the primary condition reflected by pathologically delayed pubescence and what are its causes?
- Answer 9. The primary condition reflected by pathologically delayed pubescence is gross gonadal insufficiency and might be caused by: destructive lesions of the ovaries or testes, destructive lesions of the anterior pituitary, prolonged or severe malnutrition, or protracted or severe emotional trauma.
- Question 10. What are the signs of the two types of pathological variability in primary sex characteristics?
- Answer 10. Hormonal types of pathological variability are associated with generalized underdevelopment of primary sex characteristics and sex-appropriate secondary sex characteristics. Tissue responsiveness types of variability are associated with localized underdevelopment of specific tissues and normal development of all other sex characteristics.
- Question 11. Give an example of one secondary sex condition in boys and one secondary sex condition in girls that could be caused by localized tissue under-responsiveness to same-sex hormones.
- Answer 11. Localized tissue under-responsiveness to same-sex hormones might lead to lack of facial hair in boys and underdeveloped breasts in girls.
- Question 12. What is the underlying pathology that leads to underdevelopment of all sex-appropriate secondary characteristics?
- Answer 12. The underlying pathology leading to underdevelopment of all sex-appropriate secondary sex characteristics is hormonal, due to either pathology of the gonads or the gonad stimulating portion of the anterior pituitary.

- Question 13. What is the underlying pathology that leads to overdevelopment of opposite-sex secondary sex characteristics but normal primary sex characteristics?
- Answer 13. The appearance of opposite-sex secondary sex characteristics but normal primary sex characteristics is caused by oversecretion of the adrenal cortex. This oversecretion may be caused by pathology of the adrenal cortex or of the cortex stimulating portion of the anterior pituitary.

Consistent Questions

- Question 1. The characteristic order of pubescent changes in both sexes is dependant on:
- a) age
 - b) climate
 - c) race
 - d) culture
 - e) none of the above
- Answer 1. The characteristic order of pubescent changes in both sexes is dependant on: (e) none of the above.
- Question 2. During pubescence the anterior pituitary produces which of the following pairs of hormones with what effect:
- a) corticotropic and gonadotropic; stimulates gonads and adrenal cortex respectively
 - b) gonadotropic and gonadal; stimulates gonads and adrenal cortex respectively
 - c) gonadotropic and corticotropic; stimulates gonads and adrenal cortex respectively
 - d) corticotropic and sex hormones; stimulates gonads and adrenal cortex respectively
 - e) sex hormones and corticotropic; stimulates gonads and adrenal cortex respectively
- Answer 2. During pubescence the anterior pituitary produces: (c) gonadotropic and corticotropic; stimulates gonads and adrenal cortex respectively.
- Question 3. The major group of pubescent changes which occur only within a sex group are:
- a) primary
 - b) secondary
 - c) opposite sex
 - d) same sex
 - e) none of the above

Answer 3. The major group of pubescent changes which occur only within a sex group are: (a) primary.

Question 4. Which of the following statements best describes the distribution of primary and secondary sex characteristics?

- a) primary characteristics are found in both sexes while secondary characteristics are found only in one sex group.
- b) primary characteristics are distinctive of one sex group while secondary characteristics are found only in males or females.
- c) primary characteristics are distributed only within a sex group while secondary characteristics are distributed between both sexes.
- d) primary and secondary characteristics both show variability between and within sex groups.
- e) primary but not secondary characteristics show variability between and within sex groups.

Answer 4. c) primary characteristics are distributed within a sex group while secondary characteristics are distributed between both sexes.

Question 5. Which type of distributions described below are characteristic of primary or secondary sex groups respectively?

- a) continuous overlapping; overlapping at the extremes and dichotomous.
- b) continuous overlapping; dichotomous and overlapping at the extremes.
- c) dichotomous; continuous overlapping and overlapping at the extremes.
- d) overlapping at the extremes, continuous and dichotomous.
- e) overlapping at the extremes, non-overlapping and continuous.

Answer 5. The characteristics of primary and secondary sex groups respectively are: (c) dichotomous; continuous overlapping and overlapping at the extremes.

Question 6. The male sex hormone androgen selectively stimulates the growth of:

- a) testes and facial hair and inhibits the growth of axillary hair.
- b) testes and inhibits growth of breasts.
- c) axillary hair and inhibits growth of breasts.
- d) facial and axillary hair and inhibits the growth of the uterus.
- e) breasts and facial hair and inhibits the growth of the uterus.

Answer 6. The male sex hormone androgen selectively stimulates the growth of: (b) testes and inhibits the growth of breasts.

Question 7. The average age of normal pubescence will be earlier in conditions of:

- a) extreme climates such as tropical or arctic.
- b) prolonged moderate malnutrition.
- c) good nutrition and temperate climate.
- d) good nutrition and tropical climates.
- e) good nutrition and arctic climates.

Answer 7. The average age of normal pubescence will be earlier in conditions of: (c) good nutrition and temperate climate.

Question 8. Precocious puberty is almost always caused by excessive secretion of:

- a) the adrenal cortex sometimes caused by overstimulation of the adrenal cortex by the anterior pituitary.
- b) the gonads sometimes caused by overstimulation of the gonads by the adrenal cortex.
- c) the anterior pituitary sometimes caused by overstimulation of the pituitary by the adrenal cortex.
- d) the adrenal cortex sometimes caused by overstimulation of the cortex by the gonads.
- e) the gonads sometimes caused by overstimulation of the gonads by the anterior pituitary.

Answer 8. Precocious puberty is almost always caused by excessive secretion of: (a) the adrenal cortex caused by overstimulation of the cortex by the anterior pituitary.

Question 9. Pathologically delayed pubescence reflecting extreme insufficiency of gonadal production might be caused by:

- a) damaged or malfunctioning ovaries or testes.
- b) destructive conditions of the anterior pituitary.
- c) destructive conditions of the adrenal cortex.
- d) both a) and b) above.
- e) both a) and c) above.

Answer 9. Pathologically delayed pubescence reflecting extreme insufficiency of gonadal production might be caused by:
d) damaged or malfunctioning ovaries or testes and destructive conditions of the adrenal cortex.

Question 10. Underdevelopment of primary sex characteristics which are hormonally caused lead to:

- a) localized underdevelopment of a specific tissue.
- b) pathologically delayed pubescence.
- c) underdevelopment of primary and sex-appropriate secondary sex characteristics.
- d) both a) and b) above.
- e) both b) and c) above.

- Answer 10. Underdevelopment of primary sex characteristics which are hormonally caused lead to: e) pathologically delayed pubescence and underdevelopment of primary and sex-appropriate secondary sex characteristics.
- Question 11. Localized tissue under-responsiveness to same-sex hormones in boys and girls respectively might lead to:
- a) high-pitched voice and underdeveloped breasts.
 - b) lack of axillary hair and overdeveloped facial hair.
 - c) lack of facial hair and overdeveloped breasts.
 - d) lack of facial hair and development of miniature beard.
 - e) development of breasts and miniature beard.
- Answer 11. Localized tissue under-responsiveness to same-sex hormones in boys and girls respectively might lead to: (a) high-pitched voice and underdeveloped breasts.
- Question 12. The secondary sex characteristics abnormalities produced by over-responsiveness to opposite-sex hormones and under-responsiveness to same-sex hormones are:
- a) generalized and involve several sex characteristics.
 - b) localized and involves all sex-appropriate characteristics.
 - c) generalized and involve only opposite sex secondary characteristics.
 - d) localized and involve only one secondary sex characteristic.
 - e) generalized and all other secondary sex characteristics will be normal.
- Answer 12. The secondary sex characteristic abnormalities produced by over-responsiveness to opposite-sex hormones and under-responsiveness to same-sex hormones are: (d) localized and involve only one secondary sex characteristic.
- Question 13. Abnormal development of opposite-sex secondary characteristics but normal primary characteristics may indicate underlying pathology in:
- a) the cortex stimulating portion of the anterior pituitary.
 - b) the gonad stimulating portion of the anterior pituitary.
 - c) the adrenal cortex.
 - d) both a) and c) above.
 - e) both b) and c) above.
- Answer 13. Abnormal development of opposite-sex characteristics but normal primary characteristics may indicate underlying pathology in: (d) both a) the cortex stimulating portion of the anterior pituitary and the adrenal cortex, and c) the adrenal cortex.

APPENDIX VI

Achievement Test

1. Pubescence is initiated by the _____ which increases production of _____ and begins production of _____.
 - a) adrenal cortex, corticotropic hormones, gonadotropic hormone.
 - b) anterior pituitary, gonadotropic, sex hormones.
 - c) anterior cortex, sex hormones, gonadotropic hormones.
 - d) anterior pituitary, corticotropic hormones, gonadotropic hormones.
 - e) adrenal cortex, gonadotropic hormones, same-sex hormones.
2. Precocious puberty is almost always caused by:
 - a) overproduction from the adrenal cortex.
 - b) overproduction from the gonads.
 - c) understimulation of the gonads.
 - d) understimulation of the adrenal cortex.
 - e) understimulation of the anterior pituitary.
3. Primary sex characteristics are:
 - a) by definition confined to only one sex group and can only vary between sexes.
 - b) the primary organs of reproduction and vary only within the sex groups.
 - c) all those sex-specific characteristics and can therefore vary only within the sex groups.
 - d) variable only in terms of over- and underdevelopment and therefore relevant only with a sex group.
 - e) variable only in terms of underdevelopment between sex groups.
4. The bodily changes of pubescence do not begin spontaneously but rather tend to follow each other:
 - a) in a definite order which is the same for all persons in a given sex group.
 - b) in a random order which varies among people in different climates and cultures.
 - c) in a definite order which is different for people of different age groups.
 - d) in a random order which is the same for people of the same race.
 - e) in a definite order which varies only as a product of extreme malnutrition.
5. Secondary sex characteristics may be:
 - a) dichotomously distributed.
 - b) overlapping at the extremes.
 - c) completely overlapping.
 - d) both dichotomously distributed and completely overlapping.
 - e) both overlapping at the extremes and completely overlapping.
6. Select the phrase which best describes the effects of sex hormones:
 - a) male and female hormones balance each other chemically.

- b) male and female sex hormones have either a selective or unselective effect on sex characteristics.
 - c) male and female sex hormones unselectively stimulate their sex appropriate characteristics.
 - d) male and female hormones selectively inhibit some primary characteristics.
 - e) male and female hormones selectively stimulate only sex appropriate secondary sex characteristics.
7. Before and after pubescence the adrenal cortex produces what two hormones in response to what other hormone?
- a) androgen and gonadal; corticotropic.
 - b) androgen and estrogen; gonadotropic.
 - c) estrogen and gonadal; corticotropic.
 - d) corticotropic and gonadotropic; estrogen.
 - e) estrogen and androgen; corticotropic.
8. Which of the following examples represents a characteristic which is "overlapping at the extremes"?
- a) development of rudimentary breasts in males.
 - b) development of some facial hair in females.
 - c) development of more facial hair by some females than some males.
 - d) similar development of axillary and pubic hair among both males and females.
 - e) development of more axillary hair by some females than some males.
9. Variability in primary sex characteristics is characterized by:
- a) underdevelopment only within a sex group.
 - b) over- and underdevelopment within a sex group.
 - c) underdevelopment only between sex groups.
 - d) overdevelopment only among both sexes.
 - e) overdevelopment only between sex groups.
10. i) Factors which determine individual differences and ii) the average ages of pubescence in males and females are:
- a) hormonal; 13.5 and 14.0 years.
 - b) tissue responsiveness; 14.5 and 13.0 years.
 - c) hormonal and tissue responsiveness; 14.5 and 13.0 years.
 - d) hereditary and environmental; 14.5 and 13.0 years.
 - e) hereditary and hormonal; 14.5 and 13.0 years.
11. Factors which cause pubescence to occur outside the average range of 10 to 17 years are:
- a) hereditary and environmental.
 - b) hormonal.
 - c) environmental and hormonal.
 - d) hormonal and tissue responsiveness.
 - e) related to tissue responsiveness.

12. The invariant order of pubescent changes is best explained in terms of:
- a) differential hormonal effects.
 - b) selective and unselective effects of hormones.
 - c) differential tissue responsiveness to hormonal stimulation.
 - d) unselective tissue responsiveness to hormonal stimulation.
 - e) unequal concentrations of hormones in selective tissues.
13. The term "dichotomous non-overlapping" distribution is accurate only in terms of:
- a) secondary sex characteristics which are differentiated with respect to sex groups.
 - b) primary sex characteristics which are more specific to one sex group than another.
 - c) secondary sex characteristics which are undifferentiated with respect to sex groups.
 - d) both primary and secondary sex characteristics which are differentiated with respect to sex groups.
 - e) primary sex characteristics which exist only within sex groups.
14. The kinds and sequences of pubescent changes in precocious puberty are:
- a) very similar to normal puberty but secondary characteristics more marked.
 - b) very similar to normal puberty but primary characteristics more marked.
 - c) identical in every respect to those occurring in normal puberty.
 - d) identical with the exception of slight variations in order of changes.
 - e) identical with the exception of slight variations in kind of changes.
15. The first pubescent changes in (i) boys and (ii) girls are:
- a) changing voice, pubic hair.
 - b) pubic hair, enlargement of breasts.
 - c) growth of testes, first menstruation.
 - d) growth of testes, enlargement of breasts.
 - e) increased strength, enlargement of breasts.
16. Variability in secondary sex characteristics is characterized by:
- a) both normal and pathological variability within a sex group.
 - b) underdevelopment of sex appropriate characteristics.
 - c) overdevelopment of opposite sex characteristics.
 - d) both pathological and normal variability between sex groups.
 - e) only over- or underdevelopment of same-sex characteristics.

17. Which of the following statements describes most of the conditions which might produce abnormally delayed pubescence:
- a) destructive lesions of the gonads, malnutrition, emotional trauma.
 - b) destructive lesions of the adrenal cortex, severe malnutrition, prolonged emotional trauma.
 - c) destructive lesions of the gonads or anterior pituitary, severe malnutrition, prolonged emotional trauma.
 - d) destructive lesions of the gonads and adrenal cortex, malnutrition, and severe emotional trauma.
 - e) destructive lesions of the anterior pituitary, severe malnutrition, prolonged or severe emotional trauma.
18. The only type of variability in primary sex characteristics of medical and behavioral significance is:
- a) hermaphroditism.
 - b) cryptorchidism.
 - c) overdevelopment.
 - d) opposite sex characteristics.
 - e) underdevelopment.
19. Generalized underdevelopment of same-sex secondary sex characteristics in a person with normal primary sex characteristics suggests:
- a) high adrenal cortex output.
 - b) low gonadotropic output.
 - c) low gonadal output.
 - d) high gonadotropic output.
 - e) high gonadal output.
20. Localized tissue under-responsiveness:
- a) causes sex appropriate mixup in males.
 - b) causes underdevelopment of certain sex appropriate sex characteristics.
 - c) causes overdevelopment of certain opposite sex characteristics.
 - d) causes delayed puberty.
 - e) causes precocious puberty.
21. Which of the following treatments are appropriate for abnormally delayed pubescence resulting from lesions of the ovaries or testes:
- a) medical or surgical treatment of the anterior pituitary.
 - b) medical or surgical treatment of the adrenal cortex.
 - c) injections of opposite-sex hormones.
 - d) injections of sex appropriate hormones.
 - e) both a) and b) above.
22. Localized abnormalities such as overdeveloped breasts in males is most commonly caused by:

- a) gross gonadal insufficiency.
 - b) severe and protracted emotional trauma.
 - c) localized tissue under-responsiveness.
 - d) underdeveloped opposite-sex characteristics.
 - e) low gonadotropic output.
23. The most common cause of underdeveloped primary sex characteristics is:
- a) pathologically delayed pubescence.
 - b) localized tissue under-responsiveness.
 - c) generalized tissue under-responsiveness.
 - d) gonadal insufficiency.
 - e) generalized hormonal inadequacy.
24. An abnormality which involves one secondary sex characteristic and leaves all other secondary and primary characteristics normal is probably produced by:
- a) gross gonadal insufficiency.
 - b) severe or protracted malnutrition or emotional trauma.
 - c) localized tissue over- or under-responsiveness.
 - d) generalized hormonal insufficiency.
 - e) localized tissue under-responsiveness to opposite sex hormones.
25. Generalized underdevelopment of sex appropriate secondary sex characteristics might develop from:
- a) localized hormonal insufficiency.
 - b) localized tissue under-responsiveness.
 - c) generalized tissue under-responsiveness.
 - d) generalized insufficiency of the adrenal cortex.
 - e) generalized insufficiency of the gonads.
26. Generalized overdevelopment of opposite-sex secondary sex characteristics might occur from:
- a) generalized gonadal overproduction.
 - b) localized tissue over-responsiveness.
 - c) generalized tissue over-responsiveness.
 - d) localized overproduction of gonadotropic hormone.
 - e) generalized oversecretion by adrenal cortex.

APPENDIX VII

Questionnaires

Questionnaire*

This research involves ways in which we can improve learning from text. Three different types of instructions were involved (organizers, objectives, and questions). I would appreciate your answers to the following questions.

1. How useful did you find the materials you were given to study?

extremely useful	somewhat useful	useful	not very useful	not useful at all
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>

2. Did you try to use the organizers, objectives, and questions as you studied?

used all	used most	used a few	used very few	didn't use any
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>

3. How interesting did you find learning from this material?

very interest	somewhat interesting	interesting	not very interesting	not interest- ing at all
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>

4. How do you prefer to learn from text materials? (Select as many answers as are appropriate to you)

a) just by reading b) by reading several times c) by making notes d) by underlining	e) by reciting things to myself f) by answering questions g) other (describe) _____ _____
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5. Please make any comments or ask any questions you wish regarding this research.

* For all except "text only" control group.

Questionnaire*

This research involves ways in which we can improve learning from text.
I would appreciate your answers to the following questions.

1. How useful did you find the materials you were given to study?

extremely useful	somewhat useful	useful	not very useful	not useful at all
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

2. How interesting did you find learning from this material?

very interesting	somewhat interesting	interesting	not very interesting	not interest- ing at all
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

3. Which of the following techniques or strategies did you use in studying this material?

- a) reading only
- b) reading and rereading
- c) making notes
- d) underlining
- e) reciting things silently
- f) asking myself questions
- g) other (describe) _____

4. Please make comments or ask any questions you wish.

* For "text only" control group.

APPENDIX VIII

Introduction and General Instructions

Introduction

The following general information was given by the experimenter to each group before they began to study:

I am a graduate student working in Educational Psychology and my particular interest is Instructional Psychology or Psycho-educational Design. This means that I am involved in an attempt to draw together information from various areas of research and theory to help provide ideas and information which will be useful in applied situations.

I have decided to work with text or prose materials because we still use text books and papers for a great deal of our learning experiences.

The potential benefits to you in helping me with this research is marginal for you personally. The real benefits possible are to you and I both as people who want to help promote learning.

As teachers you will often call upon learning resources prepared by other people for use with your students. I am one of these "other people" who is actively engaged in preparing instructional materials.

In order for me to prepare effective instructional materials it is important for me to investigate some of the variables involved in their effectiveness. Hopefully, some of the information I obtain, somewhere along the line in your teaching careers, will come back to you in a form that will help you help your students.

This study will take approximately one hour of your time. Your professor has permitted me to conduct this study during your regular classroom time. You will be given a package of materials, time to study, and then will be asked to write a test. The scores obtained on the test will be anonymous and will not be reflected in your course grades.

General Instructions

This package contains some text materials for you to study. Please use whatever techniques or strategies you usually use in studying from this kind of material. After 35 minutes you will be given a test.

(text only control group)

This package contains some text materials for you to study. Please follow any instructions you find within the package. After 35 minutes studying you will be given a test. (all groups except text-only control)

Achievement Test Instructions

Please read each question carefully and select ONE answer from the alternatives given. Answer each question. Please do not leave any blanks.

Delayed Test Introduction

You were not told that I would be returning to ask you to write another test for two reasons. First, some people become nervous and worried when they know they will have to write a test. I did not want you to worry about this test. Second, some people, when they know they will be tested try to prepare themselves, for example, by finding out answers to questions they did not know or by studying from other material. I am interested in finding out about what you learned when you studied the materials I gave you. Therefore, I did not want anyone to do any outside studying.

You will have 20 minutes to write this test. Please work as quickly and carefully as you can.

B30174